INTER AVIA

Review of World Aviation

In this Issue:

Max Hymans : Results of the Second Assembly of ICAO

Dive Bombers — Reconnaissance Aircraft — Castel-Mauboussin CM 10

New York Idlewild — Radar for Airports — Dr. Zipkes : Runway Surfaces

B. Gumpert : Piloting Jet Aircraft — Prof. Pirath : Development of World Aviation

Economic Navigation — Aircraft Seek Customers

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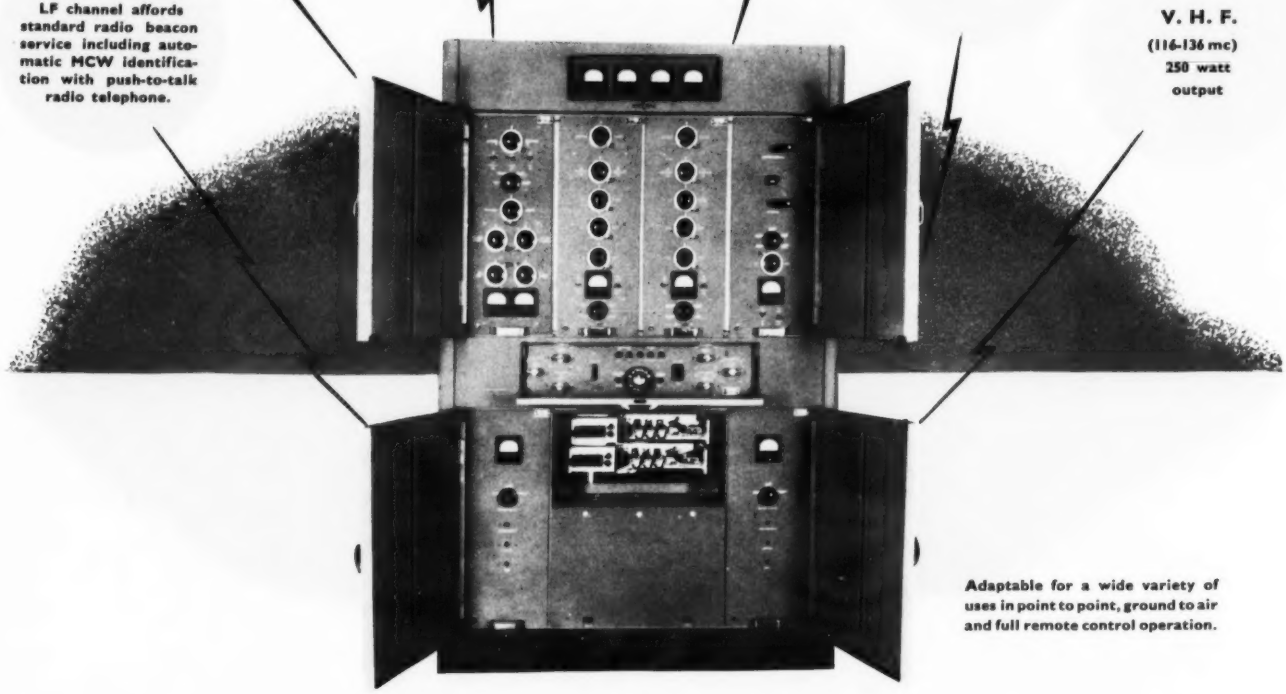

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Review of World Aviation

OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F. A. I.)

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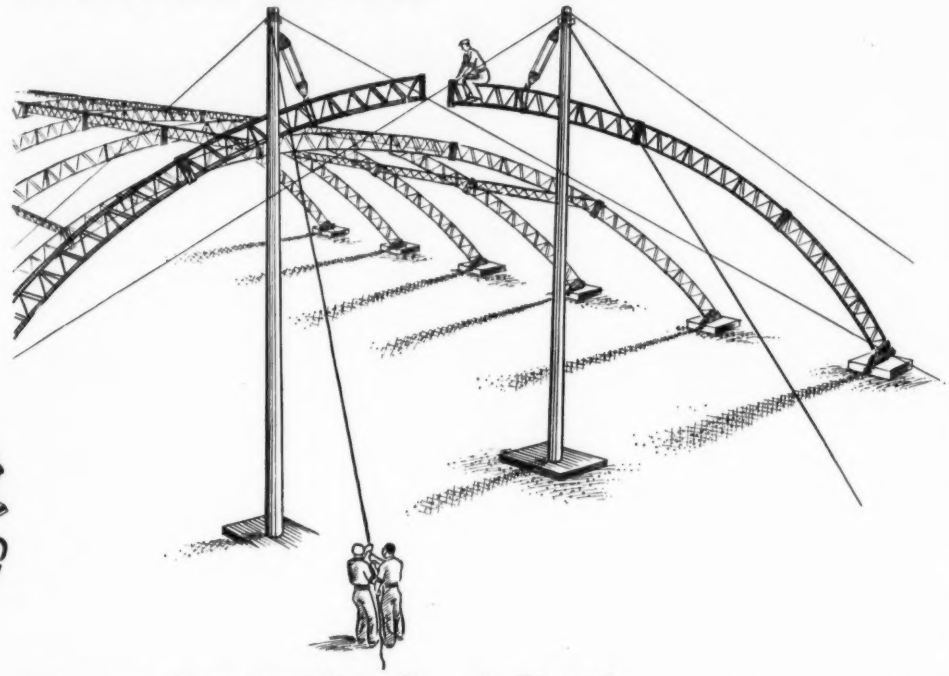

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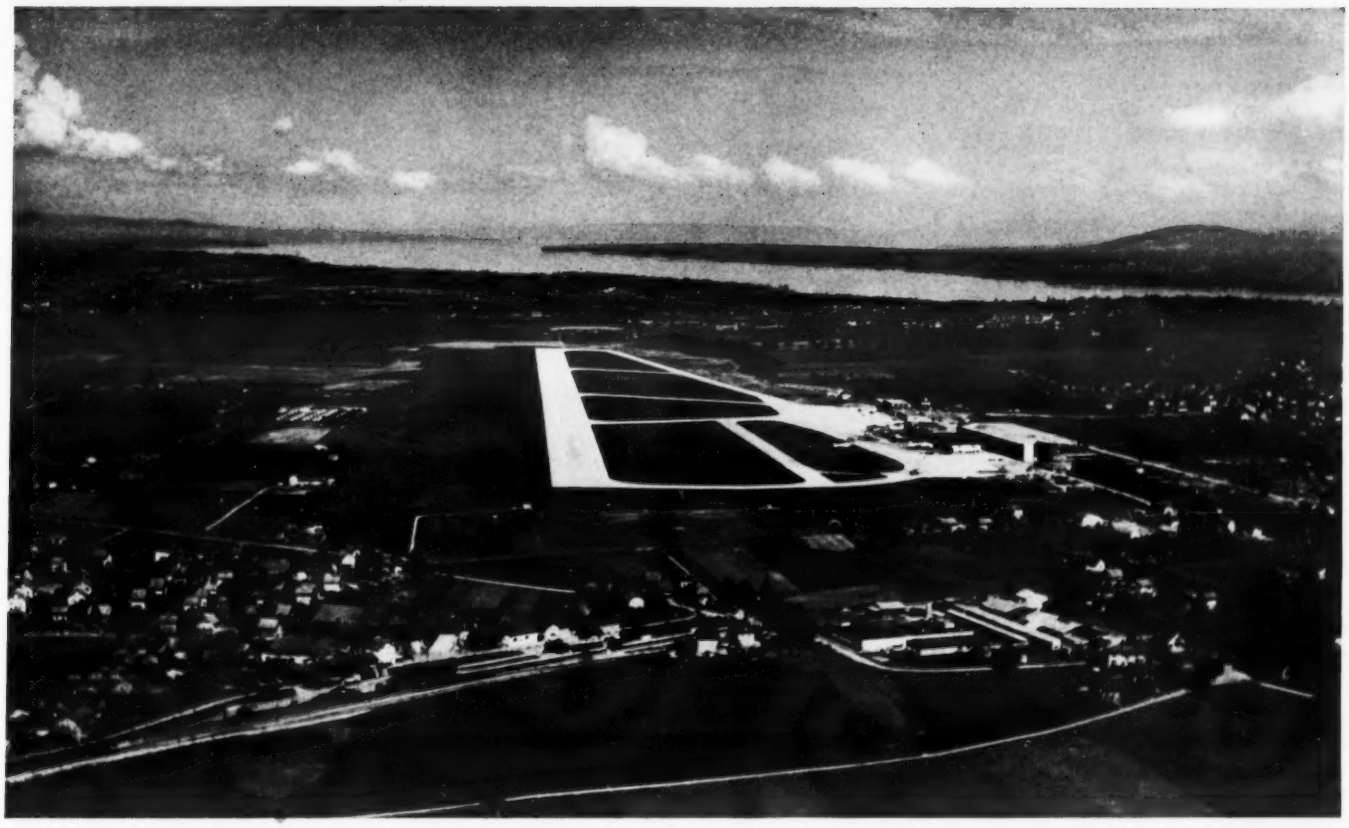

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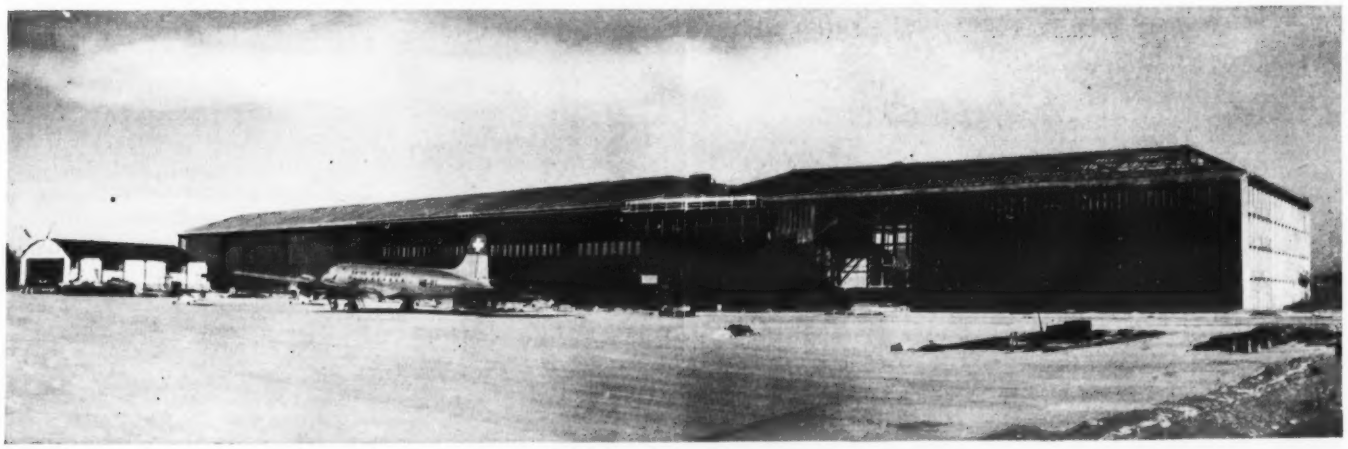
International Aviation Centre

New hangar, 560 × 200 ft., with doors 50 ft. high, now completed

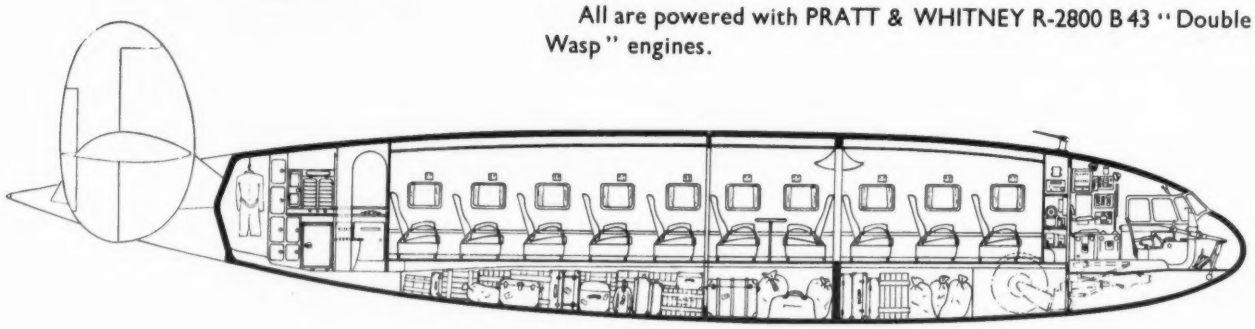


SO 30 P

" Bellatrix "

SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU SUD-OUEST are now producing 40 units of their SO 30 P " Bellatrix, " a twin-engined airliner designed for French civil aviation. Two of these aircraft left the factory a few weeks ago and are now undergoing acceptance tests conforming to ICAO standards.

All are powered with PRATT & WHITNEY R-2800 B 43 " Double Wasp " engines.



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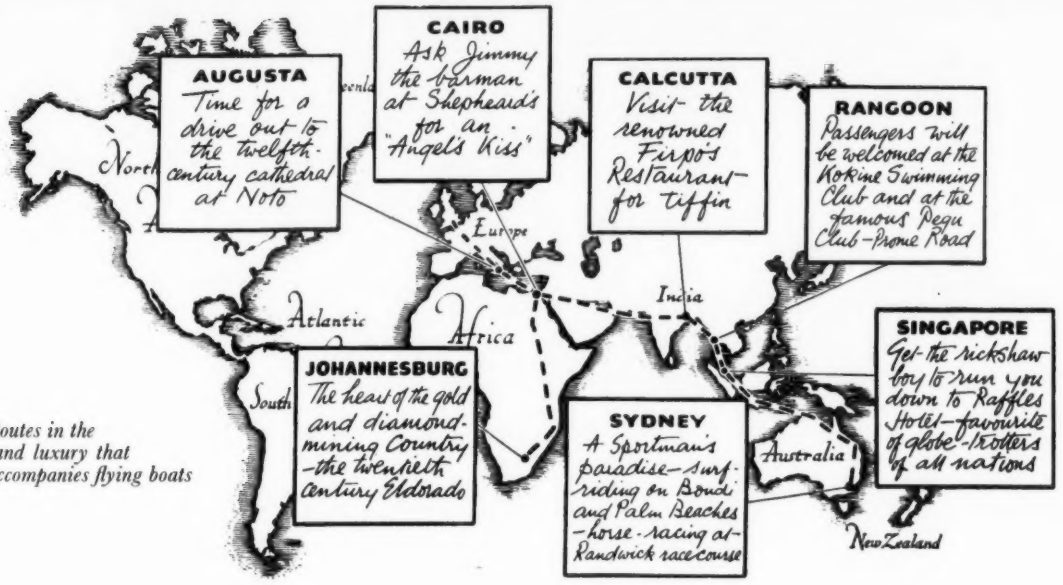
These aircraft feature the very latest equipment : luxurious, 30-passenger cabin, fitted with bar, lavatory, cloakroom; 435 cubic feet for stowing luggage; pressurisation for altitude flying, furnishing at 20,000 feet an interior pressure corresponding to 8,200 feet; sound-proofing and complete de-icing.

SNCA du Sud-Ouest are also readying a highly commercial version for carrying a greater number of passengers, and are equipping a few aircraft for mixed passenger-cargo transportation with high payload factor.

Société Nationale de Constructions Aéronautiques du Sud-Ouest

105, Avenue Raymond Poincaré — PARIS, FRANCE

Some Short jottings for airline operators, charter companies, and V.I.P.s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What does the modern business man want . . . ?

Who says he's in a hurry?

As air travel became more and more an everyday affair the popular press announced one startling record after another for reduced times between various terminals. In order to stress the importance of these facts, the press has had also to produce someone who really wanted to move about the world at these record speeds, and who fitted the bill better than the "modern business man"? He, with vast demands on his time in all parts of the world, would appear to be just the man who would be prepared to sacrifice any amount of comfort for *speed*.

Has he asked for speed?

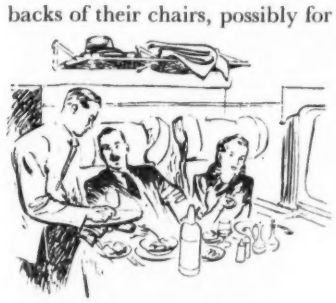
Experienced operators of airlines, such as Imperial Airways before the war and now B.O.A.C., have dealt with every type of passenger over many years. They feel that if this type of business man exists at all he is so rare as to be almost legendary. They have other, and quite different, ideas of what the modern business man requires on his long or short journeys by air. He wants to *waste* no time; travel in comfort, and have as pleasant a break from business routine as possible.

How to get him there on time...

No time is wasted where schedules can be rigidly kept and this can be achieved more easily, we suggest, with a fleet of flying boats than with any other type of aircraft. Business men—and any other passengers for that matter—want to know that they will arrive at a given place at a given time and be able to work their appointments to match. If they also have time at the intermediate stops either to enjoy themselves or do other business, so much the better.

How to make him comfortable

Give him plenty of room. Don't cramp him. Give him a cabin with no more than about five fellow passengers whose faces he can see—he doesn't want to watch the backs of their necks, or the backs of their chairs, possibly for days. Give him large windows with a wide view of passing scenery. He'll get all these and a separate promenade cabin and cocktail bar—room to move about and a changing atmosphere and view—in a Short flying boat. Soon he'll find it's fun to fly by flying boat and it's a habit that sticks.



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His flying career began in 1927, when he flew Avro 504K's with the R.A.F. Later, he had his first taste of "marine aircraft" with the Fleet Air Arm, flying Blackburns and 3Fs.

Captain Upton was one of the B.O.A.C. captains who assisted in the evacuation of Crete, camouflaged "C" class boats being used for the job.

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Marginal Notes

1st July, 1948

ICAO Gets Down to Business

The Second Assembly of the International Civil Aviation Organisation met in Geneva from June 1st to 21st, 1948. In view of the fact that the leader to our June issue revealed a certain degree of scepticism with regard to the practical results so far obtained by ICAO, it is with all the more pleasure that, after this last meeting, we find ourselves in a position to think and write optimistically. Mr. Max Hymans, the French Secretary-General for Civil Aviation, who presided over the Second Assembly, appraises ICAO's activity in an article beginning on the next page.

However, we would like to supplement Mr. Hymans' words by drawing attention to a decision taken at this Assembly ; a decision which is really something new, and which may be regarded as a bright spot on the cloudy aeronautical horizon.

Civil aviation is growing faster than ever : new personnel, new routes, new airports, new installations, new administrative finesses ; still no new social classes of passenger, but all the same new aircraft . . .

All this costs money, enormous sums of money, with personnel, insurance and aircraft forming the major item. And what about the national treasuries ? In his address to the concluding session of the Second Assembly, President Max Hymans aptly referred to the "immensity of the task" and the "inadequacy of the appropriations."

Meanwhile, what is it that was absolutely new ?

In utter defiance of all modern bureaucratic convention, the final report of the ICAO Legal Committee filled only two typewritten foolscap pages. But the novelty to which we wish to draw most attention is contained in the subject matter, notably in the annexed *Draft Convention on the International Recognition of Rights in Aircraft.*

The rights in aircraft, of course, mostly concern mortgages. And, as everyone knows, a mortgage mostly comes in useful when one requires money. You can mortgage houses, ships, and other commodities. But as regards aircraft, such a precious procedure has so far never existed. And the owners of aircraft, strange as it may sound, have never needed money as yet.

So far so good, the basis for mortgaging aircraft has now been worked out by the wise men of the Legal Committee. Unfortunately, they cannot yet agree on whether, from the legal standpoint, aircraft constitute movable or immovable property. But once they and the various governments have cleaned up this sticky point, thereby introducing rules conforming to the laws of the countries where the aircraft are registered, there will be nothing to prevent us from offering aircraft as collateral for loans and the like.

This will naturally be a great advantage. Owners and buyers of aircraft, whether individuals or companies, will be able to use mortgage rights to finance their operations or purchases. This will make matters easier for carriers wishing to acquire new equipment, and for manufacturers whose customers have not the cash in hand to buy what they want. Briefly, the aeronautical market will enjoy all the advantages possessed for centuries by the estate and shipping trades.

This revolutionary agreement has already been signed by fourteen countries. Ratification is anticipated for the near future, which signifies : A free road ahead for the airlines and the aircraft manufacturers. — Well done, ICAO.

E.E.H.

"Hitler's Pigeons"—"Clay's Pigeons"

You will probably recall the story.

When Hitler The Strategist successfully managed to get his Paulus army completely encircled in Stalingrad — as he put it, according to plan — he gave orders to the Commander-in-Chief of the Luftwaffe that Stalingrad should remain connected by transport aircraft with the rest of the front, and that aircraft should bring supplies to the besieged men. This was, of course, an absolutely marvellous idea, except that it could not be carried out. It so happened that, at the beginning of winter, 1942, the Luftwaffe had *had* transport aircraft. And any aircraft and crews which had not already been destroyed, thus a very small part of the original complement, were unfortunately right inside Stalingrad.

Glancing through his morning newspapers during the last days of June, 1948, John Citizen will surely have recalled to mind the Stalingrad story. He read that, "for technical reasons," railroad and waterway connections between the Western Zone of Germany and the Western sectors of Berlin had been interrupted. He learned, furthermore, that the Western Allies no longer had any surface communications with their sectors in Berlin. He learned, finally, that the Western Allies had unanimously decided to stay in Berlin, in accordance with the terms of the Potsdam Agreement which Russia had also signed. And since the surface connections between the West and Berlin were blocked, it was obvious to every newspaper reader — whether or not he had any idea of the strategic value of an aircraft — that the only remaining communication was by way of the air.

He was therefore not especially surprised when he read in the press that the Western Allies — in this case, as in many others, mostly the Americans — were exploiting the only remaining possibility — travelling to and supplying the three Western sectors of Berlin by means of aircraft.

This manoeuvre could not be more logical. In Western Germany the Americans can use Frankfurt, Europe's largest airport (and not due to any co-incidence) and Tempelhof airport in Berlin. The British can take off either from London or Hamburg (Fuhlsbüttel), and land in Berlin's Gatow airport. Both of them are accompanied by the kindest regards of the French. From their base at the airport of Karlshorst, the Russians are probably singing the "Karls-Horst-Wessel-Lied." And the tempo of this jovial concert is given by the staccato roar of aircraft overhead.

Whereas the American, British and French troops in Berlin, as well as the Berliners themselves, are busily receiving their canned, bottled and dehydrated nourishment by air, the Russians are feeling insulted, and at most release communiqués or barrage balloons.

All this is perhaps rather exciting for the participants and the observers, but it is not altogether without danger. Clearly, nobody wants to have an amplified repetition of the Anglo-Russian air crash of April 5th, when fifteen people were killed near Gatow. As for the Berliners, as long as they are not too hungry and not absolutely frozen because of the lack of coal, they must be rubbing their hands, for — no matter to which party they belong — they are probably saying to themselves : "Good old Adolf was right, democracy is no good, be it red, pink or sky-blue." Try to put yourself in the place of an "occupied person" : after all, would it not suit his purpose admirably if the G. I. Joes, Tommies and Ivans started knocking each other out ? *Tertius gaudens !*

However, the matter is by no means humorous. As a matter of fact, it can become very serious.

Nobody can fail to be impressed by a reference in the House of Commons on June 30th, to a "very serious situation," by Britain's cautious Foreign Secretary, Ernest Bevin. The same goes for a suggestion on the same day by a Conservative member, that every aircraft should be used to bring back from Berlin the families of British occupational troops, but also replace them with paratroopers or commandos.

We read that the U. S. General Staff in Washington occasionally presses a button and has squadrons of four-engined transport aircraft transferred to Western Germany from Alaska, the Caribbean, and other areas. We read that these so-called transport manoeuvres are being stepped up. Of course, we are free to think that the Americans are rich enough, materially, to indulge in such jokes, but — despite the Marshall Plan and all their lavish generosity — the Yankees are not in the habit of simply throwing their money out of the window.

For the present it concerns transport aircraft, thus ostensibly unarmed aircraft. But though the noise of the engines in Berlin's skies may sound pleasant to the people besieged there, and bring comfort to many Berliners, it sounds somewhat loud to the ear of the impartial observer. Today there are more aircraft flying between West and Central Germany than in any other part of the world. Let us hope that there will be less tomorrow.

E.E.H.

During the Second Assembly of ICAO : centre, Mr. Max Hymans, President of the Assembly ; left, Mr. Edward P. Warner, President of the Council ; right, Mr. Albert Roper Secretary-General.

Results of a Meeting

Reviewing the Second Assembly of the International Civil Aviation Organisation Geneva, June 1st to 21st, 1948

By Max Hymans, Secretary-General of Civil Aviation for the French Government

The author is known internationally as the head man in French civil aviation. He was unanimously appointed President of the recent Second Assembly of ICAO, and can therefore be regarded as an authority on international aviation questions.

Born in Paris in 1900, he is an engineer and a lawyer. In 1928, following a short career in industry and as a barrister in the Paris law courts, he was elected Deputy of the Department of Indre. During his subsequent political career, he presided over numerous committees at the Chamber of Deputies and was notably selected to brief the Chamber on the Aviation Budget ; he also functioned as Under-Secretary of State in the Ministry of Trade, and later in the Ministry of Finance. As a captain in the 31st artillery regiment, he was frequently decorated during the War, during which he played a prominent part in the Resistance Movement. In October, 1941, a warrant was issued for his arrest. He reached England in 1942, where he was appointed Director of Air Transport in the French Commissariat of Aviation. In this capacity he united the various air services of the French Committee of Liberation.

Nominated to head the French delegation at the 1944 Chicago Conference, he has since continued to re-organise civil aviation, and notably Air France. Now Chairman of the Board of the French national airline, he will in all likelihood take the helm completely, as Director-General, in the near future. The Editor.

What kind of a milestone does the Second Assembly of the International Civil Aviation Organisation represent along the road travelled since the Chicago Conference ? In what measure has ICAO fulfilled the hopes which characterised its birth ? How much further must it continue in order not to disappoint forty-eight countries who have placed their trust in it ? These are some of the questions asked by those who are interested in the future of international air transport.

In order to answer these questions conclusively, it is first necessary to compare the results accomplished with the aims defined in the fundamental programme.

This programme is clearly set forth in the Chicago Convention, adhered to by the countries helping to keep ICAO alive. By this Convention, ICAO's aims can be broadly divided into two main categories : the technical aims ; the political and economic aims.

*

The first-mentioned aims concern the *equipping of international air routes* (airports, equipments for aerial navigation and traffic control), as well as the elaboration and implementation of standard methods for aiding navigation and controlling airway traffic.

As regards the *political and economic aims,* these envisage the division of traffic and regulation of competition between operators of different nationality, or different types of transportation. They also concern international co-operation through the organisation of collective operations of international services and through the removal of administrative measures impeding the development of air transport.

*

In the technical domain, ICAO has already achieved concrete results. Governments of the majority of contracting States have made serious efforts to equip in accordance with ICAO standards and recommendations, those sections of international air routes situated over their respective national territories.

The task requires long-term planning, for the problems to be solved are numerous and complicated. We only need to take the apparently simple example of the decision to introduce a standard system of measures for maps and navigational instruments. This reform is imperative if navigational techniques are to be standardised throughout the world. But it will seriously disturb the habits of navigators, who will have to renounce their national system of measures, and it will incur considerable expenses since navigational instruments and maps will have to be replaced. Moreover, the transition period will be a critical one as regards safety, unless national precautions are taken to facilitate the transfer from the old to the new system. The realisation of this task by progressive evolution will, therefore, require several years' work.

Difficulties of a similar nature, though less grave, arise in all technical domains subjected to international regulation, since new methods invariably upset certain old habits and frequently call for the replacement of equipment or the utilisation of new equipment. These problems are rendered all the more delicate, as the systems at present in competition for a certain number of navigational and airway control operations are often far from being perfected or have not yet completely proved their practical utility. An example is given by the procedures for guiding aircraft along the airways, where systems using the intersections of hyperbolic patterns are face to face with systems using directional beacons and distance-measuring equipment. A premature decision in this connection might cause equipments to be adopted, which would later have to be scrapped to make way for others considered more suitable.

One only needs to consider that equipping international air routes today entails many millions of dollars, in order to understand that ICAO must proceed with the utmost caution if it is not to incur useless expenses for governments, all of which are at present hard-put with budgetary worries.

Taking all this into account, it must be admitted that the standardisation of equipment and procedures has progressed considerably where international air routes are concerned, and also that all governments have accepted the majority of the recommendations made by ICAO, signifying the latter's incontestible authority in this respect.

The question now arises as to what results, in this field, did the Second Assembly of ICAO achieve.

First of all, it examined the reports in which the various countries indicated their own progress in the application of standards concerning airports, air navigational equipment, airway traffic control, meteorological services, rescue organisations, aeronautical maps, operating methods, certificates of airworthiness, and certificates of competency of airmen. It also studied a large number of suggestions contained in these reports.

Since no agreement could be reached on a certain number of questions, these were passed on to the Council, which received directives from the Assembly to :

> establish a programme for providing and maintaining indispensable equipment, by regions or air routes, at the same time suggesting an order of priority and indicating the time limit for installation ;
>
> replace, as soon as possible, the present Air Navigation Committee of the Council, with an air navigation commission, consisting, as prescribed by the Convention, of twelve members selected internationally from those proposed by member States.

The first of these decisions will enable countries to work out their budgets in accordance with the burdens assigned them. The second will give birth to an organ fully qualified to pursue the technical tasks assigned to ICAO.

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In the economic and political field, it must be confessed that ICAO's progress since the Chicago Conference is less spectacular. Indeed, it has *not succeeded in introducing the Multilateral Agreement on International Rights in Civil Aviation,* which constitutes one of its principal goals. However, evidence of neglect should not be inferred from this fact. It would be nearer the truth to say that ICAO was a victim of certain illusions when it thought to accomplish such a complex task in less than two years. Nevertheless, these two years of study and discussion have already led to a result, the importance of which it would be wrong to underestimate : thanks to those years, the airfaring countries have become more intimately acquainted with the real nature of this difficult problem and of its implications.

What is the main obstacle to its solution ? Surely it is the circumstance that the total quantity of airline trade existing today, is still too small to enable all the companies competing on the international network, to live without State subsidisation. There is no formula for multilateral agreement which is capable of solving this veritable squaring of the circle, except perhaps that consisting of reducing the carriers to a reasonable number by organising collective operations of international services over the principal routes (Europe—U.S.A., Europe—South America, Europe—Africa, Europe—Far East, Pacific area) and the regional networks (European, South American and Asiatic).

But a fair division of operations for a collective scheme like this would require exact quantitative and qualitative knowledge of airline trade, according to the countries of origin and destination. And such knowledge cannot be gained unless ICAO, with the help of member States, establishes methodical traffic statistics. Furthermore, the birth of really collective operations would have to be preceded by the solution of the legal, administrative and political problems involved in the creation of truly international commercial organisations. This is why the Assembly in Geneva asked the Council to study these questions, simultaneously using the information and suggestions furnished by the various States. In this way, the Council will be able to lay before the next Assembly, to meet in 1950, a report allowing for the solution of problems pertaining to the situation as it will be in two years' time.

Meanwhile, it is clear that, by the time two years have elapsed, the problem of distributing international traffic, which now dominates world air transport politics, will have become seriously complicated by the appearance of new modes of transportation. Until recently, the expression "civil aviation" referred only to the *scheduled operators whose aircraft transport passengers, mail and freight.* The simplicity of this concept is already out of date. Nowadays, and for the past two years, civil aviation has also included *specialised cargo carriers,* certain of which are assuming a scheduled character over routes connecting principal trade zones ; *charter carriers* of certain categories of goods or passengers (e. g. displaced persons) ; *pleasure flights* and *air taxis.* Each of these new air transport activities trespasses, in some way or other, on the domains of the traditional scheduled operators, but all the same fulfils new needs, with which the regular carriers could only cope in a limited measure. Thus governments are endeavouring to clear the way for these new arrivals, all without compromising the financial structure of the established scheduled airlines. These endeavours, which have so far been organised according to local ideas, must be co-ordinated if every company concerned with international air transport is to find roughly the same political climate all over the globe. The Assembly therefore asked the Council to study this problem also, and, as always, to request suggestions from the Governments concerned.

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It is by considering the task of ICAO from the above angle that one can best appreciate the farsightedness of its founders, who, by

Showing the ICAO conference hall at the Geneva Palais des Nations.

creating the Permanent Council, have simultaneously given birth to a sort of *miniature general assembly.*

In it are represented all the regions of the globe and all the groups of nations, by men thoroughly qualified to handle every air transport problem. This Council is therefore able to pursue, effectively, the study of problems arising during each Assembly meeting, and present the following Assembly with solutions which are practical and characteristically universal.

The chief *merit of the Second Assembly,* recently held in Geneva, is doubtlessly contained in the fact that it was more conscious that preceding Assemblies of the efficacy of this instrument, and that it granted it two years in which to consider the important problems set before it.

An organisation as vast as ICAO may not work hurriedly, nor may it attempt to achieve immediate results. It must plan for the future.

In conclusion, it should be remarked that ICAO's vitality is manifested by the increasing number of member countries. Austria and Finland were accepted as members by the last Assembly, which brings the number up to fifty. Of these, thirty-two took an active part in the Second Assembly, whilst six non-member countries sent observers. Other participants included seven international organisations whose activities are connected in some way with international civil aviation.

An ICAO sub-committee in session.

New York - Idlewild Inaugurated

When New York celebrates a jubilee, something new is invariably dedicated. On the occasion of this year's commemoration of the City's Golden Anniversary, celebrating the entry of Manhattan, The Bronx, Brooklyn, Queens and Richmond into the big city, it was the turn of New York International Airport, at Idlewild, which is to supplement the over-loaded La Guardia Field and replace the latter where overseas operations are concerned. Perhaps in 1998 people will deliver moving speeches in praise of the farsightedness of those men who secured New York's leading position in world aviation ; perhaps people will grumble about the unbearably small size of Idlewild, or even mock those men who took so much trouble to provide for a means of transportation since become useless . . .

Just how much trouble was taken ? Up to spring, 1942, the 4,900 acres comprising the site of Idlewild consisted, in the main, of marshy tideland. In order to render it stable, 61,868,000 cu. yds. of sand had to be pumped out of the neighbouring Jamaica Bay, 9,380,000 cu. yds. of earth had to be excavated, 64 miles of drain pipes, of 8 to 72 inches diameter, had to be laid. About 3,600 acres of beach grass had to be sown for stabilising the sand.

With this, a swamp was turned into a dry plain — but still not into an airport. For the latter, hard surface runways must be erected for departing and arriving aircraft. Six open parallel runways have already been constructed, each pair being 4,500 to 7,000 feet apart. The longest is 9,500 feet, and follows the edge of Jamaica Bay ; the five other runways measure between 6,000 and 2,500 feet. A seventh runway measuring 8,000 feet, now under construction, is to be equipped specially for instrument landings ; located perpendicular to the longest runway, it will be completed some time next year.

The runways possess reinforced concrete surfaces, 200 feet wide and 12 inches thick, with 50-foot asphalt shoulders on either side. They enclose a drawn-out hexagon, on which an oval area of about 6,900 by 3,900 feet is foreseen as terminal area. This area comprises a wide outer belt of waiting aprons for aircraft and is connected with the runways by 100-foot-wide taxiways. In its centre are to arise terminal and administration buildings, garages, stores and hotels ; it is even planned to build up a modern sports arena, and a recreation park. For the present, however, the constructions can be compared with those of the majority of unfinished airports on both sides of the Atlantic : a temporary terminal building, with Quonset-type extensions to house passenger waiting rooms, ticket and operational offices, emergency equipment, etc., with a control tower on the roof.

For the present a provisional road leads from the administration building to Southern Parkway, a highway which follows the northern limits of the airport site. However, good communications will later be provided by the Van Wyck Expressway, which forms an extension to Queen's Boulevard, crosses

Southern Parkway and the airport property line via a clover-leaf junction, and merges directly into the terminal area by a underpass beneath the apron belt. The Civil Aeronautics Administration and the U. S. Weather Bureau have already leased space near the Van Wyck Boulevard entrance for their regional offices. Expected to be ready for use by April 1st, 1949, this will be a three-storey office building, 400 feet square, and will cost about $4,500,000.

At the edges of the airport, outside the runway hexagon and terminal area, several other large buildings are to arise. It is clear that many airline companies will not be content merely to have administration buildings at Idlewild, but will also desire extensive facilities for maintaining and overhauling their flying equipment. The City of New York has already partly fulfilled their wishes in this respect, by erecting two hangars, each 200 by 300 feet. Two further hangars, each of which will be 300 feet wide by 225 feet deep, with doors that can accommodate aircraft up to 60 feet in height, should be completed late in 1949.

Apart from runways, administration buildings and hangars, however, it is logical that an ultra-modern airport must possess vast facilities for airway traffic control and instrument guidance of aircraft coming into land. But as elaborate and modern as Idlewild may be in this respect, developments in this field are in such a state of flux that, for the inauguration of the new airport, the authorities have had to restrict their installations to proven and generally accepted equipment.

For instrument landing, there is a standard C.A.A. system, comprising the usual transmitters for defining the localiser plane and glide path, and three marker beacons erected along the approach line to the runway. Meanwhile, this is not absolutely logical, since it is known that local conditions at La Guardia field forbid the utilisation of a standard glide path transmitter. The installation at Idlewild, however, represents a considerable improvement, in that it features an all-weather illumination of the instrument runway, with lights sufficiently brilliant to penetrate the thickest fog and already recognisable to a pilot when he is over the approach radio marker.

As a further aid to landing, precision beam and airport surveillance radar (modified and improved G.C.A., serviced by one man) has been ordered. This will enable aircraft to be guided by the ground station, but because of delivery delays, it cannot be placed in operation until late 1949. In this connection, too, the illumination of the approach funnel will fill a gap which has long been endangering operations.

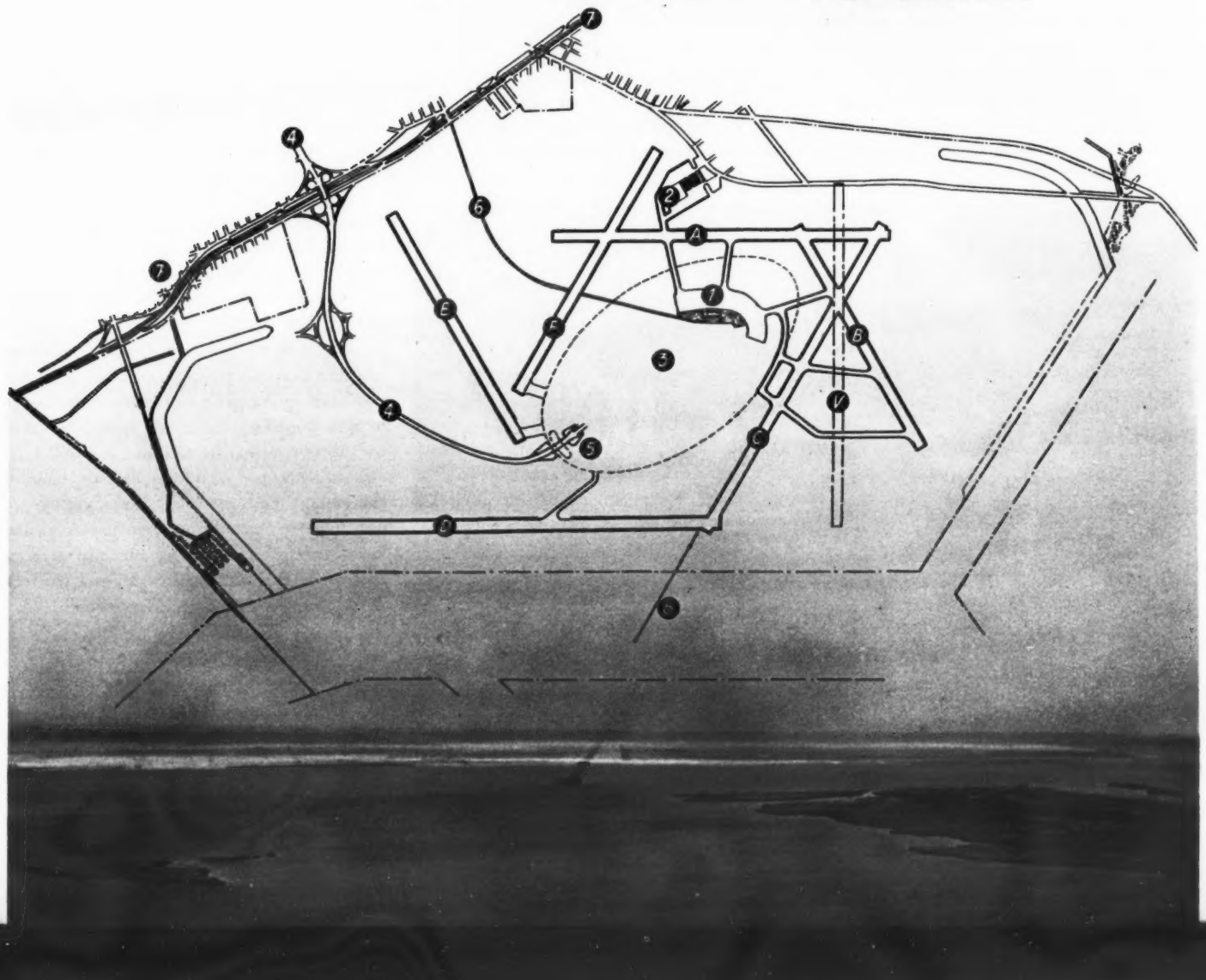
Initial operating minima for instrument approaches will be a 400-foot ceiling and one-mile visibility. However, these minima may be reduced to a 300-foot ceiling and $^3/_4$-mile visibility, once pilot proficiency is established.

The afore-mentioned all-weather approach light system is installed on instrument runway "C" which, like the new instrument runway "V," leads inland from the edge of Jamaica Bay. Since this means that the approach path is mostly over water, a three-thousand-foot-long pier has been built to extend into the bay. This pier, together with the short strip connecting the end of the runway with the edge of the bay, carries 35 Krypton flash units teamed with 35 neon blaze units, all lamps being supplied by Westinghouse Electric Co. Flashing forty times a minute to produce artificial lightning flashes of 17,000,000ths of a second duration, the small, pencil-size Krypton tubes, powered by a 2,000-volt surge, flash with a maximum of 9,000,000 candlepower per square inch, and give forth the brightest light ever produced artificially. This is magnified by the fixture's optical system to 3,300,000,000 peak beam candlepower. As the separate lamps are energised successively

The airport's present stage of completion.

Runways :
A : 8,000 ft. (in service)
B : 6,000 ft. (in service)
C : Instrument, 8,200 ft. (in service)
D : 9,500 ft. (completed)
E : 6,000 ft. (completed)
F : 6,500 ft. (completed)
V : New instrument, 8,000 ft. (ready by 1949)

1 : Temp. Adm. Bldg. & Contr. Tower (in service)
2 : Two hangars (in service)
3 : Terminal area
4 : Van Wyck Expressway (ready by 1950)
5 : Underpass (building)
6 : Temp. approach road (in service)
7 : Southern Parkway
8 : Approach light pier (in service)



The all-weather approach light system for instrument runway "C" is mounted on a 2,500-foot-long timber pier extending from the end of the runway into Jamaica Bay. The row of 70 lighting units is made up of Krypton flash units of 3,300,000,000 peak beam candlepower (brightest light ever built) alternated with neon blaze units of maximum 10,000 candle power. The vertical rods on top of the lights are bird-guards to keep the seagulls from alighting.

at intervals of four thousandths of a second, the total flash appears as a stroke of lightning travelling from the end of the pier to the runway threshold, calling the attention of the pilot and indicating his direction and altitude. The Krypton lamps are only used at full power during thick fog, but even then can easily be recognised from a distance of 1,000 feet. When flying over the inner radio marker, located 3,500 feet from the end of the runway, the pilot will already be able to see the flash. With this equipment, therefore, arises the first instance in which a perfect transition from the initial approach stage to visual reference is provided for all weather conditions.

The neon blaze units are built up of two-foot-long tubular neon lamps, placed one above the other, six high. Used as a flashing light, the blaze unit produces a peak candlepower of 10,000, but as a rule — both during the day and the night — they will be used as steady burning lights, yielding a red glow of 100, 1,000, or 10,000 candlepower, according to visibility conditions. Alongside the actual runway, the Krypton and neon chains join with rows of standard Bartow lighting units.

The above described instrument runway "C," with its radio aids and light system, represents an ultra-modern and even an unique installation. But it might be compared with the trump card in the hand of a bridge player whose partner has also placed a suit of trumps on the table : it happens that the approach direction of this runway crosses that

Showing the control tower on the roof of the temporary administration building.

of La Guardia Field, and it will require every skill on the part of the airport traffic controllers to master more traffic with both airports than with one of them. Unfortunately, the cards had already been dealt and runway "C" built when this was discovered. However, the accelerated completion of the new instrument runway "V" will help to remedy the situation.

The cost of all this is a story in itself. Between April, 1942, and May 15th, 1948, the City of New York spend around $60,000,000 on the New International Airport at Idlewild. The Port of New York Authority, which in 1947 undertook to complete, operate and expand the airport, intends investing a further $100,000,000 during the coming years.

The airline companies have already been provided with a schedule of charges for the use of public landing, ramp and apron areas, parking and storage areas, incinerator and porter service, and for Federal inspection service space and mail-handling space. Though the Authority's Board of Commissioners maintain that these fees are lower than those charged at La Guardia Field, the airline companies find that, in view of the present incomplete state of Idlewild, they are rather high ; they also fear a future increase should airport operation ultimately prove to be more expensive than expected.

Meanwhile, the Port Authority know perfectly well that their investments can never be justified and amortised solely through the dues they collect from airline companies. There is no absence of business flair here, however, and a method has been conceived whereby the passengers using the airport will help to make up for any shortages. Who are better customers than passengers — especially the ladies — who disembark with limited amounts of luggage ("I simply haven't a thing to wear !") or find just before departing that they have not completed all their intended purchases in the great city ("We really ought to take something home for mother") ? It is for this reason that the terminal area will contain shopping and recreation facilities, offering everything the heart can desire and every possibility of spending the last "free" dollars. And this stream of dollars will also play its part in making the world's biggest city the biggest crossroads of world aviation.

The two completed hangars, each 200 by 300 feet, are to serve primarily for maintenance of those aircraft that have so far found no room at La Guardia Field. Two slightly larger hangars are under construction.

Castel-Mauboussin

CM 10

Cargo Gliders and Aerial Trains

Now that the glider-tug aircraft combination has proved its utility in many fields during the War, efforts are being made to use this wartime experience to further the ends of civil aviation. Many firms are building new types of cargo glider or developing new versions from models already used for troop and material transport during the War. From the large number of existing types, mention may be made here of the GC-18A "Avitruc" developed in the U.S.A. by Chase Aircraft Co., Inc., the war-proven British Airspeed "Horsa" and General Aircraft "Hamilcar," the French Castel-Mauboussin CM 10, which is described below, and the Italian Aeronautica Lombarda A.L. 12 P cargo gliders. Even this very incomplete list serves to show that the potentialities of the cargo glider, and also of the aerial train, have been recognised in most parts of the world, leading to concrete developments in all countries possessing an adequate aircraft manufacturing industry.

The Soviet Union carried out extensive experiments with aerial trains. Initially, these were confined to the Moscow—Novosibirsk and Gorki—Kuibischev air routes, and devoted to the carriage of a wide variety of cargo commodities. The Scientific Institute for Civil Aviation, responsible for these flights, is now planning to extend the tests to passenger transportation and intends operating aerial trains under adverse weather conditions (instrument flying). It is obvious that the carriage of goods and passengers by means of aerial trains can only attain practical value if executed with great safety and regularity.

When the French began planning a glider suitable for utilisation in aerial trains, however, they clearly recognised that safety and regularity were not the only factors necessary, but that transportation of this type must also give satisfaction from the economic standpoint. The commercial value of the tug-glider combination, meanwhile, is also very greatly influenced by the qualities of the glider itself.

Castel-Mauboussin CM 10 cargo glider.

Cockpit fitted with dual controls; crew entrance door on the left.

Fuselage nose, including cockpit, can be swung open to the right; control rods, electric cables, and tubes for the hydraulic system, pass through the lower hinge and need not be disconnected.

Since none of the various types of cargo glider operated during the War could meet the requirements of civil aviation, French engineers began plans which have resulted in the design of a modern cargo glider, the *Castel-Mauboussin CM 10*. Whereas development and construction of the prototype was carried out by *Etablissements Fouga & Cie.* in their aircraft division at Aire-sur-Adour (Landes), production has been assigned to the National *SNCA du Nord* concern, who have a contract from the Government civil aviation authorities for twenty-five units, which they are building at their Sartrouville and Meaulte factories. The prototype CM 10 made its firsts flight in June of last year, and further models of this design are at present being tested at the Mont-de-Marsan and Brétigny experimental establishments.

In the development of the Castel-Mauboussin CM 10 (named after its designers, Castello and Mauboussin), special value was attached to structural features which would enable the price of production to be kept low.

In principle, it is a cantilever high-wing monoplane of composite construction, the main material being wood. The two wing halves are built up as independent units and can be detached without difficulty. Powerful split flaps and a medium wing-loading allow for low gliding speeds and consequently guarantee safe landings even on primitive airfields. Spoilers located about half way between the fuselage and wing tips also help to cut down landing speed.

To facilitate maintenance and overhaul work, the fuselage is built up of individual assembly units. The nose encloses the pilots' compartment, which is fitted with dual controls, a complete set of blind-flying instruments, and a telephone for communicating with the tug aircraft. The entire nose section, including the cockpit, can be swung to the right through 90 degrees, thus giving access to the full width and height (5 ft. 9 in. × 7 ft. 1 in.) of the cargo hold. There are 1,130 cu.ft. of utilisable volume, and the 140 sq. ft. of floor area are stressed to withstand up to 92 lb./sq. ft. Though the hinged nose section is of metal, wood has been used throughout the remainder of the fuselage.

The non-adjustable horizontal and vertical stabilisers are of wooden construction, plywood skinned; the elevator and rudder, on the other hand, are formed of fabric-covered metal frames.

The undercarriage comprises two main wheels, held by a single strut against the wing and two against the fuselage, and a steerable dual-wheel nose-gear, which is retractable in flight. A special device enables the main undercarriage to be lifted so as to lower the fuselage on to a skid. Whereas this enables the cargo floor to be lowered to 1 ½ feet above the ground so as to facilitate loading and unloading operations, it also enables the skid alone to be used for landing on small and primitive airfields.

Characteristics:

Span	87 ft. 7 1/4 in.
Length	58 ft. 5 5/8 in.
Height	19 ft. 8 in.
Wing area	775 sq. ft.

Weight distribution:

Operational task	Carriage of 35 equipped soldiers	Carriage of 2 jeeps	Carriage of varied goods
Tare weight (lbs.)	6,245	6,175	6,120
Crew (lbs.)	190	190	380
Payload (lbs.)	7,720	6,505	8,930
Gross weight (lbs.)	14,155	12,870	15,435
Wing loading at max. gross weight			19.9 lb./sq. ft.

Performance:

Max. permissible towing speed	186 m.p.h.
Speed at best gliding angle	99 m.p.h.
Rate of sink in free glide and at speed of 87 m.p.h.	8.2 ft./sec.
Landing speed	59 m.p.h.
Requisite tug force:	
at 124 m.p.h. tug speed	990 lbs.
at 186 m.p.h. tug speed	1,545 lbs.

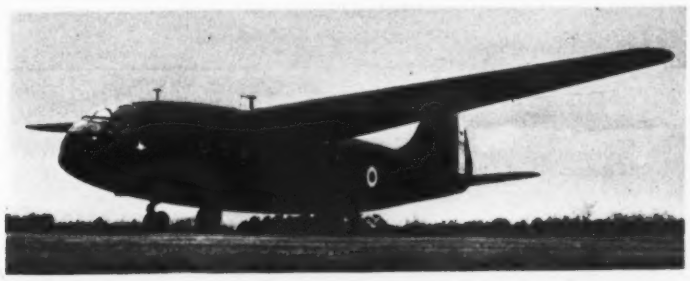
A glance at the weight distribution table clearly reveals the wide utility offered by the CM 10. Apart from military purposes, this glider was all the same designed primarily for freight and mail carriage. A promise of further operational versatility is contained in the fact that the CM 10 can be combined with four different types of tug aircraft: the three engined Junkers Ju 52 transport, the four-engined British Handley Page "Halifax" and the four-engined French So 161 "Languedoc" airliners, and the C-47 "Skytrain" troop transport version of the Douglas DC-3. These possibilities should simplify the otherwise difficult problem of combining a suitable tug aircraft with a suitable glider.

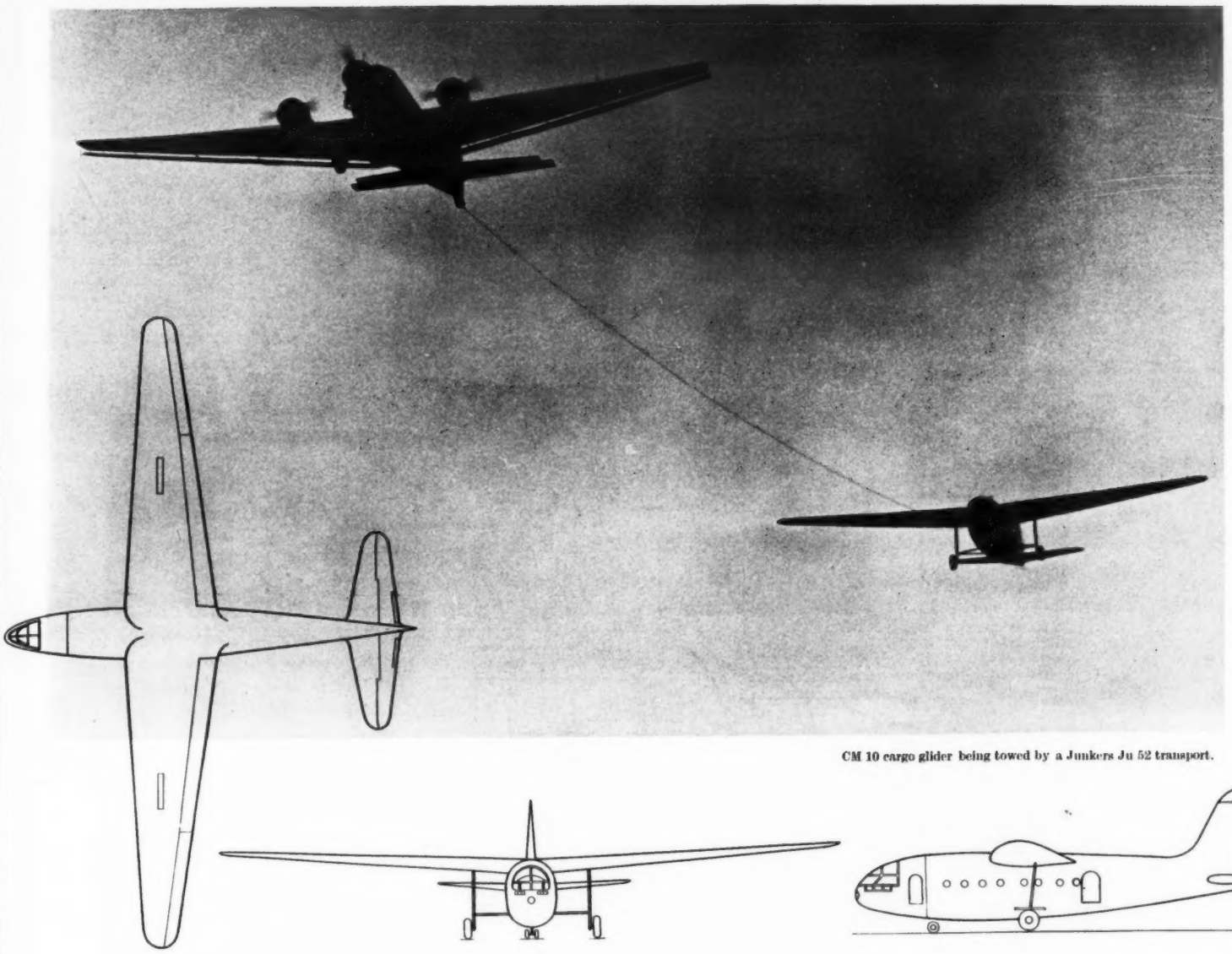
Comparison of weights and performance when using different types of tug aircraft.

	Ju 52	"Halifax"	SO 161	C-47
Total weight of combination (lbs.)	31,415	78,260	63,270	35,270
Payload of tug aircraft (lbs.)	2,980	8,160	12,125	2,920
Payload of glider (lbs.)	4,410	8,820	8,820	6,615
Recommended cruising speed (m.p.h.)	103	180	175	137
Initial rate of climb (ft/sec.)	2.6	7.38	6.2	3.3
Take-off run (yds.)	820	1,370	1,310	940
Service ceiling of combination (ft.)	4,900	—	—	8,200

The undercarriage is normally extended for taxiing, as well as for taking off from and landing on suitable airfields.

Cargo hold accessibility is improved by retracting the nose-wheel and raising the main undercarriage. In this position the CM 10 comes to lie on a skid, not shown in this picture. If a suitable airfield is not available, landings are made on the skid alone, with retracted undercarriage.





CM 10 cargo glider being towed by a Junkers Ju 52 transport.

Regular freight and passenger services with gliders have so far never been undertaken, since a tug-glider combination does not stand up particularly well to bad weather conditions, and also because this type of service would incur complications as regards ground service. The purely flying difficulties can be eliminated to some extent by the use of the already successfully-proven rigid tow-bar as connection between the glider and tug. This method replaces the usual steel cable with a steel tube of about five feet in length. Able to move horizontally and vertically in its joint at the tail of the tug aircraft, this bar usually has a ball-and-socket type of joint to connect it with the nose of the glider, thus enabling the latter to move within certain limits. Already tried out in Germany, this tug method is at present meeting with success in the U.S.A.

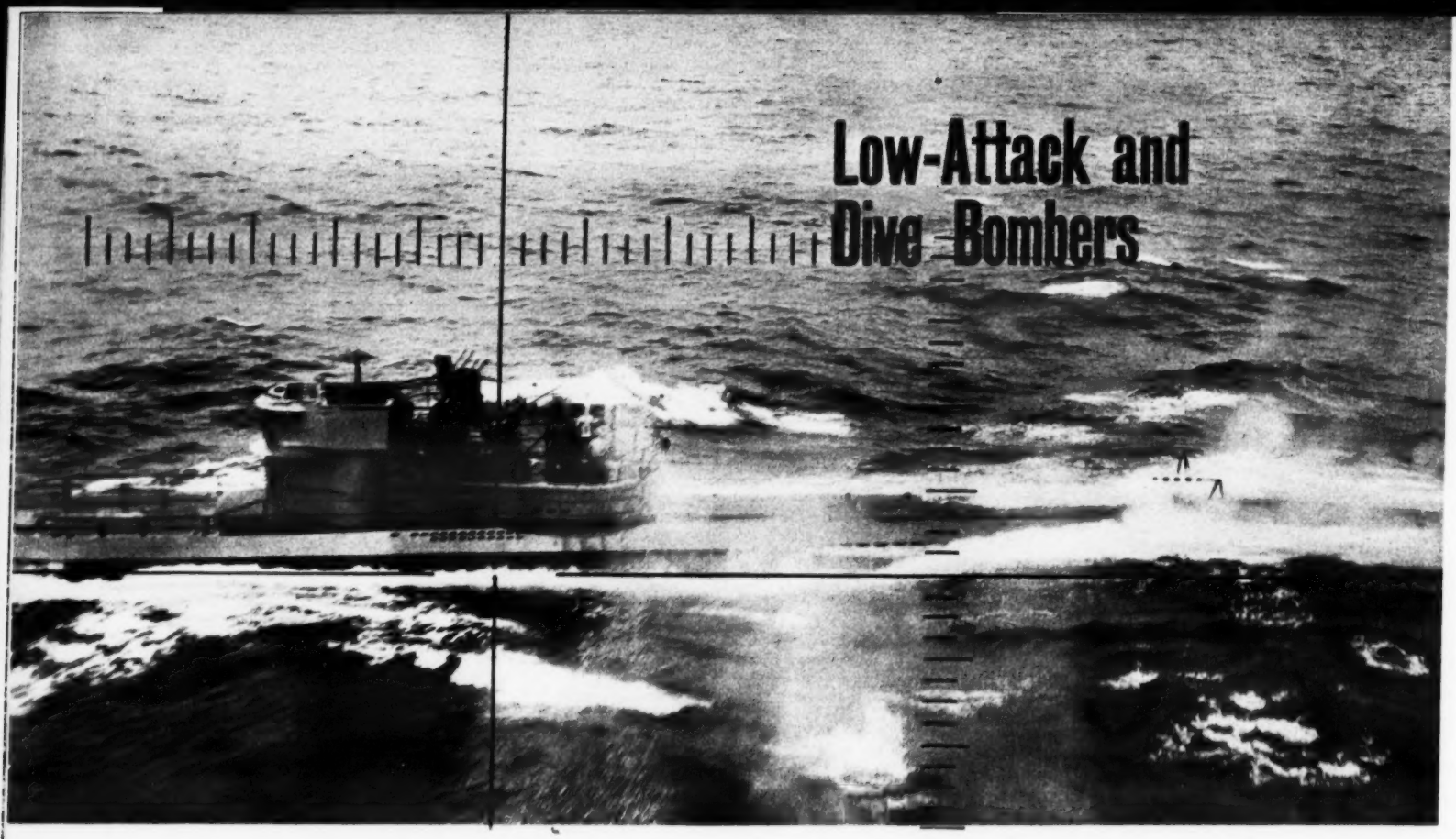
Experience has shown that the rigid tow-bar method simplifies both the launching procedure and the aerial towing as such, and that the entire flight is much smoother. Another advantage is that the short rigid bar precludes all possibility of a collision of the two aircraft, as well as the glider wing's entry into the slipstream of the tug aircraft if the flight attitude is normal. The most noteworthy feature of the method, however, is that it makes the combination almost entirely independent of weather conditions. The glider pilot is so near to his tug that, even under the worst of visibility conditions, he can still see the tug's empennage and use it as a reference to maintain a normal flight attitude. Altitude and direction are of course automatically maintained by the rigid connection.

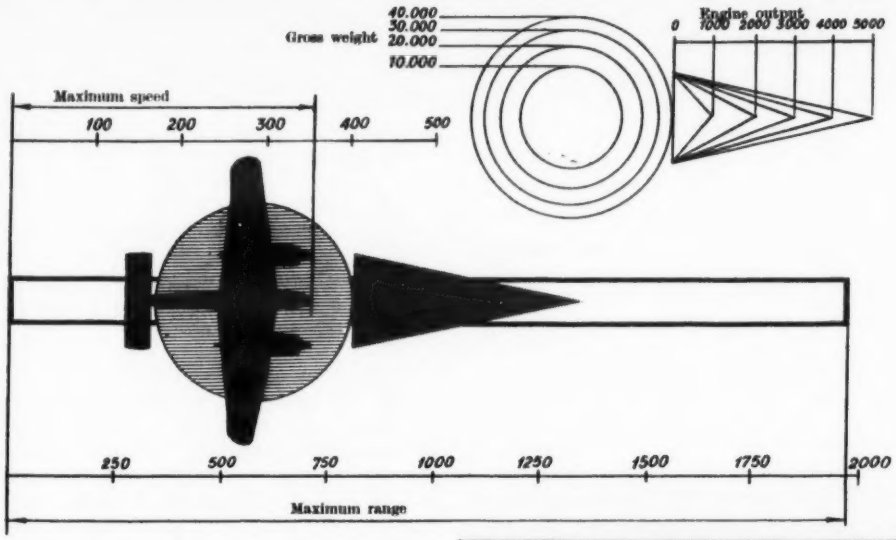
The desire for greater independence and freedom of movement for the glider, in solo flight or after landings, has been manifested in many ways. In order to make a glider able to fly independently for a short while after release, auxiliary engines with airscrews are provided ; small electric motors are installed for driving the undercarriage wheels, so that the glider can taxi under its own power and thus not be dependent on a special ground service.

In conclusion, we would point out the increasing tendency to use glider aircraft as progenitors for passenger and transport aircraft. Etablissement Fouga & Cie., for instance, have derived two twin-engined commercial aircraft from the CM 10 cargo glider ; these are the Castel-Mauboussin CM 100 and CM 101, passenger and cargo transports, respectively, which are approaching completion. Featuring almost exactly the same external configuration as the original CM 10, these powered versions are being built to accommodate 21, 14, and 11 passengers, all cargo (two versions), and each has two air-cooled twelve-cylinder in-line engines of 580 H.P. for take-off.

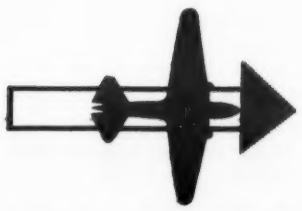
The concept of the cargo and the troop transport glider, it would seem, has been realised simply because, during the War, money did not matter as long as the military purpose was fulfilled. But while military transport gliders were usually expendable equipment, and more often than not built for one operation only, this is by no means the case in civil aviation. Hence, if we have to wait a long time before aerial trains are used for freight and passenger carriage, then this is not so much because there is a lack of suitable flying equipment, but owing to the still incompletely clarified organisational problems attached to the creation of suitable ground services. Finally, as long as the air pick-up technique for gliders is not perfected, it is likely that this method of transportation will be reserved for military use. *Ba.*

Low-Attack and Dive-Bombers

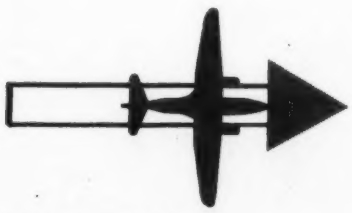




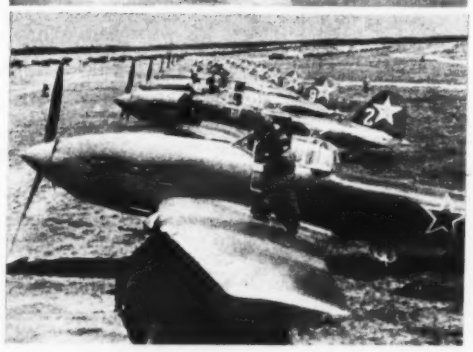
The black silhouettes give an idea of the size and configuration of the aircraft; their distance from the ground line on the left indicates the maximum speed. The length of the rectangular strip corresponds to the maximum possible range. Take-off weight is indicated by the area of a circle, and engine power (in horsepower) by the area of a triangle.



Ilyushin IL-2 "Stormovik" (U.S.S.R.).



Ilyushin IL-10 (U.S.S.R.).



Four Russian, four British, four American, one French, one Swedish and one Argentine aircraft comprise the foregoing group, which closes the gap between the review of piston-engined fighter aircraft in our March issue and that of the long-range bombers published in July. Restricted to those types specially designed for low-level attack and dive-bombing operations, the present article is concerned with flying equipment for land and sea warfare, but not for aerial warfare: the passive opponents are tanks, communication centres, command and supply bases on land, ships and submarines on water. The active opponents are the light anti-aircraft cannon. Their best protection against enemy fighter aircraft is to be escorted by fighters.

The combat equipment of the aircraft listed here, has to be versatile, since they have to deliver, from the low altitudes in which they

operate, the best suited means of destruction against specific targets : fragmentation bombs and machine-gun fire against exposed objectives, explosive shells or rocket missiles against tanks ; medium bombs, eventually with time fuses, against bunkers and buildings, and torpedos against ships. The manoeuvrability required of an attack aircraft, which, in the case of a dive-bomber, is provided by aerodynamic brakes even in dive flight, allows for the installation of fixed guns, firing forwards, as in the case of fighters.

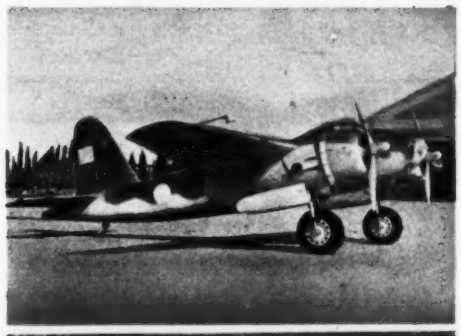
For this reason no sharp distinction can be made between fighter and attack aircraft. And since we previously listed all single-seater attack aircraft, namely torpedo-aircraft and torpedo-fighters, in disregard of their combat value, in the category of pure fighters under the heading of piston-engined fighter aircraft (March, pages 138 and 139), we must supplement the present review with a brief allusion to those types already dealt with. In reality, we ought to present all these piston-engined fighters and single-seater attack aircraft, since all of them can be used for low-level attacks and dive-bombing, if fitted with bombs, rockets and eventually torpedos. But as this would require too much space, we shall present this supplementary list in the order of the maximum speeds, breaking it off where this speed indicates a certain degree of fighter ability — outside the operational range of enemy jet fighters.

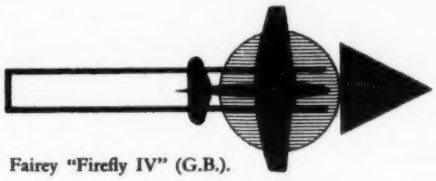
	Max speed m. p. h.	Bomb load lbs.
Douglas AD "Skyraider"	*c.* 300	4,000-6,000
Blackburn "Firebrand"	340	2,000
Martin AM "Mauler"	350	4,000
Northrop P-61 "Black Widow"	375	6,400
Blackburn S.28/43 "Firecrest"	380	c. 2,000
De Havilland "Mosquito"	404	2,000
Grumman F7F "Tigercat"	427	4,000
Westland "Wyvern"	456	(Torpedo)

More distinct than the division between fighter and attack aircraft, however, is that between such aircraft and the long-range bombers dealt with in our July issue. Even a patrol bomber possessing, for its category, such a small bomb load and range as the Vickers "Warwick," is still nearly 6,000 lbs. heavier than the Bristol "Brigand" long-range attack bomber, which is a distinct example of a dive bomber fitted with dive brakes ; at most, the Lockheed "Harpoon" could be compared, operationally, with its nearly twice as heavy successor, the "Neptune," for its predecessor, the "Ventura," though utilisable during the War as a low-attack aircraft, was nevertheless not especially successful.

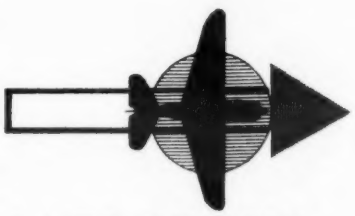
What, then, are the general conclusions which can be drawn from this investigation ?

Inst. Aerotecnico de Córdoba I.Ae. DL-24 "Calquin" (Argentina).

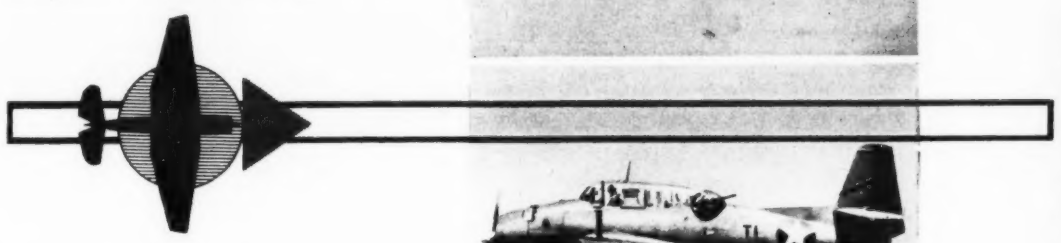




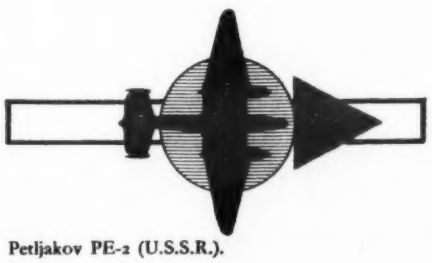
Fairey "Firefly IV" (G.B.).



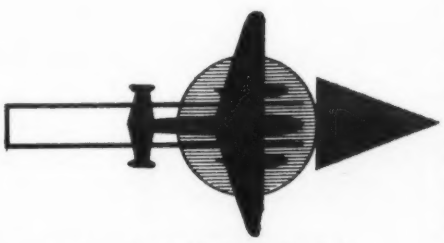
Curtiss SB2C-5 "Helldiver" (U.S.A.).



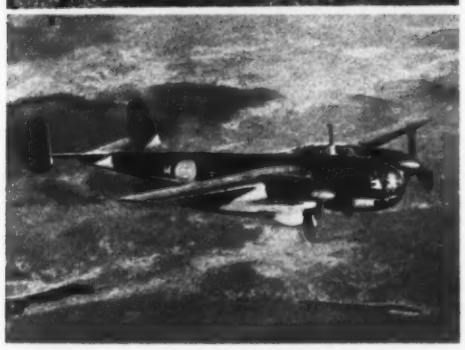
Grumman TBM-3 "Avenger" (U.S.A.).

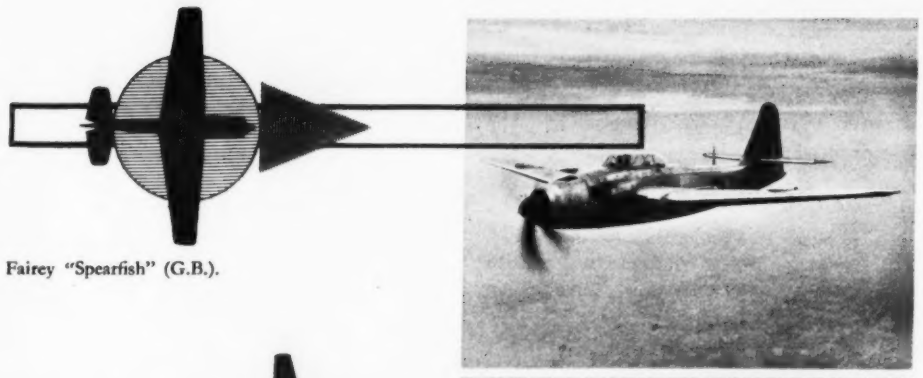


Petljakov PE-2 (U.S.S.R.).

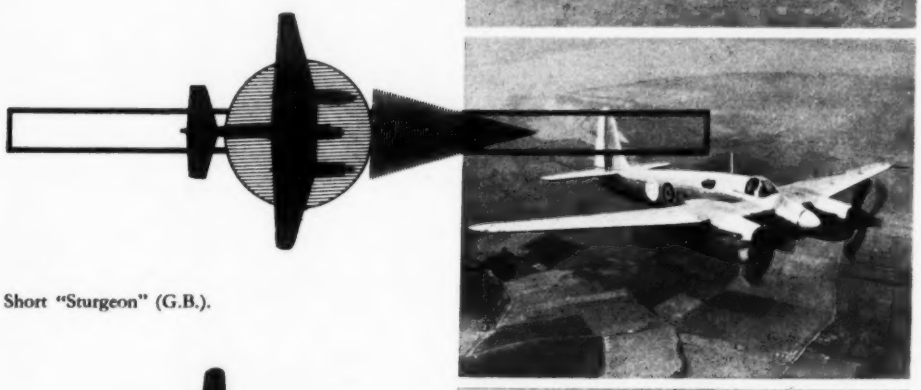


Svenska Aeroplan SAAB B-18B (Sweden).

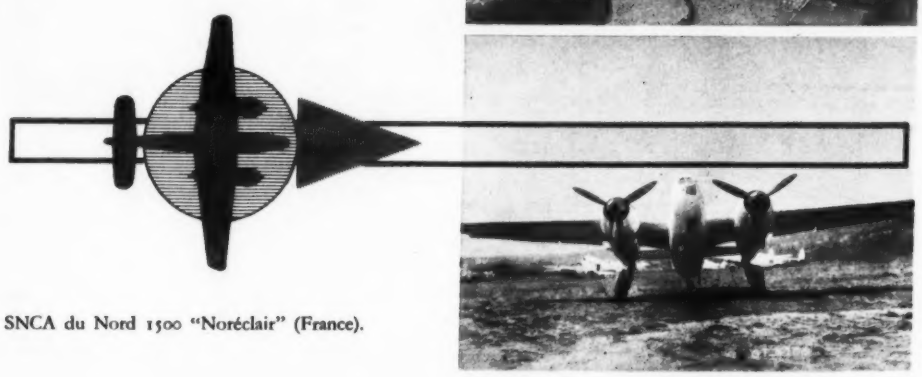




Fairey "Spearfish" (G.B.).



Short "Sturgeon" (G.B.).

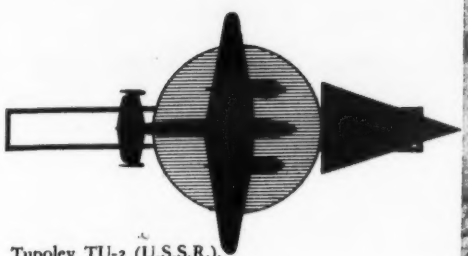


SNCA du Nord 1500 "Noréclair" (France).

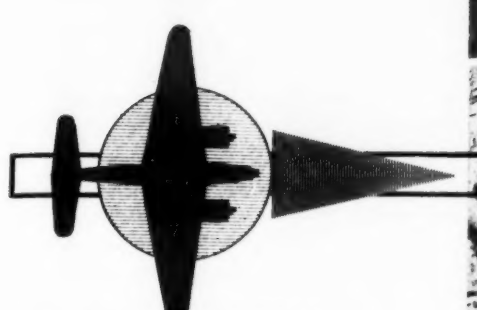
The facts mentioned at the beginning, that Russia possesses just as many types of low-attack aircraft as any other nation and that this design is primarily an instrument of land warfare and not of aerial warfare, supplement each other. For the Russian art of war is the art of land warfare ; even today their concept of airborne warfare seems to be a tactical affair, which is just as difficult to separate from ground troop operations—once cavalry and today tanks — as it is from the artillery. The equipment of this "flying artillery" is, of course, the low-attack aircraft and not the heavy bomber, and one may assume that the developments, mentioned here, of the well-known IL-2 "Stormovik," PE-2 and TU-2 models of the last war, are still available in large quantities today.

For England and the U.S.A., however, the attack aircraft, as a carrier of torpedos, is an instrument of sea warfare. For tactical attacks against ground targets it would seem that the development of special aircraft types, such as the "Stuka" utilised by the Luftwaffe, has proved to be superfluous. These countries, to whom the concept of aerial warfare is by no means foreign, and who maintain large independent air forces, possess single-seater fighters which, though primarily built for fighting in the air, can easily be loaded with bombs, rockets and cannon, and operated against ground targets. And it is fitting that we draw attention here to the perfected instrumentation for aircraft, power plants, radio equipment, and armament, as well as the extensive training of pilots in these countries,

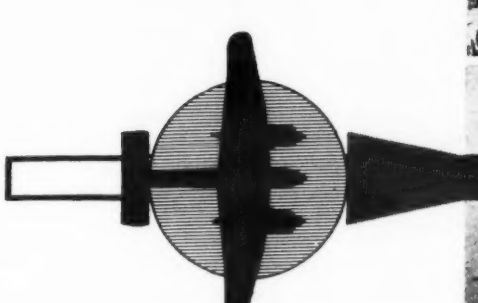
Country	Manufacturer or Designer	Aircraft Designation	Crew	Power Plant	Max. power	Dimensions			Weights		
						Span	Length	Wing area	Gross Weight	Wing loading	Power loading
					H. P.	ft. in.	ft. in.	sq. ft.	lbs.	lb./sq. ft.	lb./H. P.
U.S.S.R.	Ilyushin	IL-2 "Stormovik"	2	1 × M 38 (12-cyl. V.)	1,300	47' 10"	38'	....	....	....	....
U.S.S.R.	Ilyushin	IL-10	2	1 × AM 42 (12-cyl. V.)	2,000	....	....	....	....	....	....
Argentina	Instituto Aerotécnico de Córdoba	I. Ae. DL-24 "Calquin"	2	2 × P & W "Twin Wasp"	2,400	53' 6"	39' 4"	409	14,300	35	6.0
G.B.	Fairey	"Firefly IV"	2	1 × R.-R. "Griffon 74"	2,300	41' 2"	38' 9"	335	14,200	42.4	6.2
U.S.A.	Curtiss	SB2C-5 "Helldiver"	2	1 × Wright "Cyclone 14"	2,000	49' 9"	35' 8"	422	15,000 +	35.5	7.5
U.S.A.	Grumman	TBM-3 "Avenger"	3	1 × Wright "Cyclone 14"	1,700 +	54' 2"	40'	490	15,550 +	31.7	9.2
U.S.S.R.	Petljakow	PE-2	3	2 × M 105 R (12-cyl. V.)	2,200	56'	41' 5"	435	18,700	43	8.5
Sweden	Svenska Aeroplan	SAAB B-18 B	3	2 × DB 605 B	2,960	55' 9"	43' 5"	471	19,400	41.2	6.5
G.B.	Fairey	"Spearfish"	2	1 × Bristol "Centaurus"	2,800	60' 3"	44' 7"	530	22,000	41.5	7.9
G.B.	Short Bros.	"Sturgeon"	3	2 × R.-R. "Merlin 140"	4,160	59' 11"	44' 9"	560	21,700 +	39 +	5.2
France	SNCA du Nord	Nord 1500 "Noréclair"	3	2 × SNECMA 14 R	3,160	64' 6"	46' 10"	495	23,800	48	7.5
U.S.S.R.	Tupolev	TU-2	4	2 × M 82 (2-radial)	3,440	61' 10"	45' 3"	....	28,300	....	8.2
U.S.A.	Lockheed	PV-2 "Harpoon"	5	2 × P & W "Double Wasp"	4,600	75'	c. 52' 6"	c. 645	c. 31,000	c. 48	6.7
G.B.	Bristol	164 "Brigand"	3	2 × Bristol "Centaurus"	5,600	72' 4"	46' 5"	718	39,300	54.8	7.0



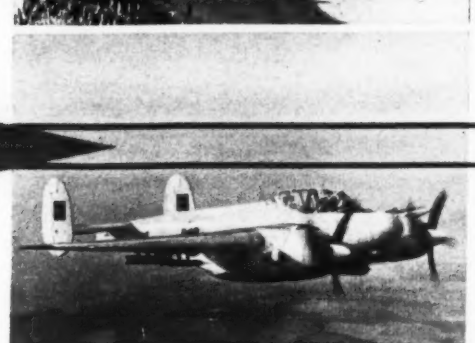
Tupolev TU-2 (U.S.S.R.).



Lockheed PV-2 "Harpoon" (U.S.A.).



Bristol 164 "Brigand" (G.B.).



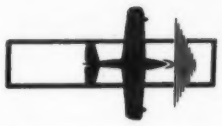
which has made it possible to use single-seater aircraft for carrying heavy bombs and torpedos. This does not seem to be the case in the Soviet Union.

The yardstick for the speed of an attack aircraft is rather contained in the speed with which light anti-aircraft guns can be manoeuvred, than in the speed of enemy fighters. In order to elude ground defences, and be able to execute surprise low attacks, manoeuvrability may not be sacrificed in favour of high speed. Thus it is to be seen that no attack aircraft, having simultaneously to fulfil fighter duties, possesses a speed in excess of about 400 m.p.h. ; which also means that none of them are jet-propelled, and even goes so far as denote that the development of this aircraft category has not progressed since the end of the War.

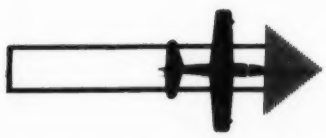
Is it, then, that this lack of progress signifies that the low attack aircraft, as such, is obsolescent and likely to be superseded by forthcoming rocket artillery ? We are inclined to answer in the negative. What the Russian projects are leading to, we can only leave to conjecture. Maybe that Hitler's Messerschmitt Me 262 "Blitzbomber" will be resurrected over there. And there are unmistakable signs that the Western Powers are endeavouring to have jet fighters carry bombs and rockets, thus giving them a rôle hitherto assigned to the piston-engined fighter. Thus the jet fighters of today can become attack bombers tomorrow.

Performance				Guns		Jettisonable war load	Armament and additional equipment	Remarks
Max. speed	Service ceiling	Max. range	Normal range	AC = Automatic cannon MG = Machine gun			B = Bomb T = Torpedo R = Rocket missile A = auxiliary tank	Other versions
m. p. h.	ft.	miles	miles	fixed	flexible	lbs.		
c. 280	....	....	....	2 AC 23 mm. 2 MG 7.6 mm.	.. MG ..	440 +	8 R 55 lb. or 2 AC 37 mm.	
280 +	....	....	....	2 AC 23 mm. 2 MG 7.6 mm.	.. MG ..	*c.* 2,200	4 B 550 lb. or 8 R 55 lb. or 2 AC 37 mm.	Development of "Stormovik"
300	*c.* 31,000	....	....	4 AC 20 mm.	—	1,760		
386	....	1,400	....	4 AC 20 mm.	—	2,000	2 B 1,000 lb. or 16 R 60 lb. ; radar ; 2 A	Naval reconnaissance fighter
....	....	....	1,000 +	2 AC 20 mm.	1 MG 0.50 in.	2,000 +	B ; 8 R 5 in. ; camera	Carrier-borne dive bomber experimental versions for torpedo attacks : XBT2C-1 with Wright "Cyclone 18" (345 m.p.h.). XBTC-2 with P & W "Wasp Major" (single-seater, 367 m.p.h.)
278	22,600	2,470	....	2 MG 0.50 in. 1 MG 0.30 in.	1 MG 0.50 in. 1 MG 0.30 in.	2,000	1 B 2,000 lb. or 4 B 500 lb. or 1 T or 1 A	Carrier-borne torpedo aircraft
335	*c.* 28,000	1,000 +	....	2 AC .. 2 MG ..	2 MG 0.50 in.	2,200	2 B 1,100 lb. or 4 B 550 lb. or 10 B 220 lb.	Also as reconnaissance fighter (PE-3)
354	....	....	....	1 MG ..	2 MG ..	....		Also as long distance reconnaissance aircraft (S-188)
292	25,000	*c.* 1,500	1,030	2 MG 0.50 in.	2 MG 0.50 in.	2,000	1 B 2,010 lb. or 4 B 495 lb. or 1 T or 1 A (180 Imp. Gall.) ; 16 R ; radar	Carrier-borne multi-purpose aircraft
420	36,400	1,700 +	1,050	2 MG 0.50 in.	—	1,000	1 B 1,000 lb. or 2 B 500 lb. or 1 A or 8 R ; radar ; camera	Carrier-borne scout bomber, now used as target tug
335	....	2,140	....	2 MG ..	2 AC 20 mm. 2 MG ..	....	1 T	
350	....	....	1,000 +	2 AC 20 mm.	2 MG 0.50 in.	*c.* 5,000		Standard U.S.S.R. low attack aircraft
300 +	25,000 +	....	2,000 +	5 MG 0.50 in.	4 MG 0.50 in.	4,000	B or 1 T or 8 R or 2 A	
358	26,000	2,770	2,000	4 AC 20 mm.	1 MG 0.50 in.	4,000	B or 1 T or 8 R or 2 A (380 Imp. Gall.)	Dive bomber developed from Bristol "Buckingham"

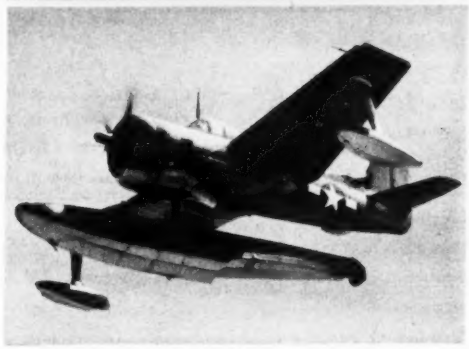
Search and Photo Reconnaissance Aircraft



Edo XOSE-1 (U.S.A.).



Curtiss SC-2 "Seahawk" (U.S.A.).



These two pages are devoted to mentioning briefly a number of aircraft types which could not be rightly placed in the categories dealt with so far.

If he wishes quickly to find out what is going on in a restricted combat sector, over which no other air operations are taking place just at that moment, a commanding officer will usually assign the reconnaissance mission to any fighter or light bomber which happens to be available, if the sector is over land or in coastal waters. There are scarcely any aircraft left today, which are designed specifically for scouting missions. A special case, however, is presented by the necessity for short-range reconnaissance on the high seas. For this purpose, aircraft have to be catapulted from cruisers and be able to land on water. For such duties, the U.S. Navy possesses a couple of one-to-two seater types equipped with a central float: the Curtiss SC-2 "Seahawk," whose single-seater SC-1 version proved its utility during the war in the Pacific and which can also be fitted with landing wheels for operation from aircraft carriers; and the less powerful Edo XOSE, which is at present being tested.

Meanwhile, another type of aerial reconnaissance which is gaining importance—and not only in the military domain—is aerial photography and survey. Gone are the times when, for such duties, just any kind of aircraft could be used, in which the pilot was accompanied by an observer working a portable camera. The elaborate camouflage methods perfected during the War, and the peacetime progress in survey technique, call for extremely accurate and versatile photographic equipment, which can only be installed in special designs of aircraft—eventually in place of the armament.

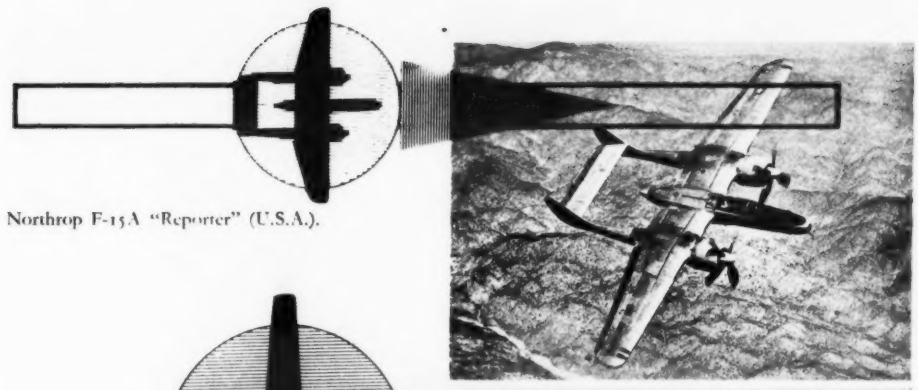
Country	Manufacturer	Designation	Crew	Power Plant	Max. power H.P.	Dimensions: Span ft. in.	Dimensions: Length ft. in.	Dimensions: Wing area sq. ft.	Weights: Gross weight lbs.	Weights: Wing loading lb./sq.ft.	Weights: Power loading lb./H.P.	Performance: Speed m.p.h.	Performance: Service ceiling ft.	Performance: Range miles
U.S.A.	Edo	XOSE-1 XOSE-2	1 2	1 × Ranger V-770-8	550	38'	31' 1"	237	....	....	....	200+	....	1,000+
U.S.A.	Curtiss	SC-2 "Seahawk"	2	1 × Wright "Cyclone 9"	1,425+	41'	36' 5"	....	....	....	....	250+	28,000	650+
U.S.A.	Northrop	F-15A "Reporter"	2	2 × P & W "Double Wasp"	5,600	66'	50' 3"	664	28,000	42.3	5.0	440+	35,000+	4,000+
U.S.A.	Hughes	XF-11	2	2 × P & W "Wasp Major"	6,000+	101' 5"	65' 5"	983	58,300	59.5	9.7	420	44,800	5,000
France	SNCA du Sud-Est	SE 1010	6+	4 × SNECMA 14 R	6,320	101' 9"	71' 6"	1,251	66,000+	52.8	10.4	350	34,400	4,500
U.S.A.	Republic	XF-12	7	4 × P & W "Wasp Major" with exhaust turbo-jet	12,800+	129' 2"	93' 10"	1,640	101,400	61.9	7.9	450+	44,000	4,500

As regards British and American fighters and bombers which have been re-equipped for this purpose, mention can be made of the following :

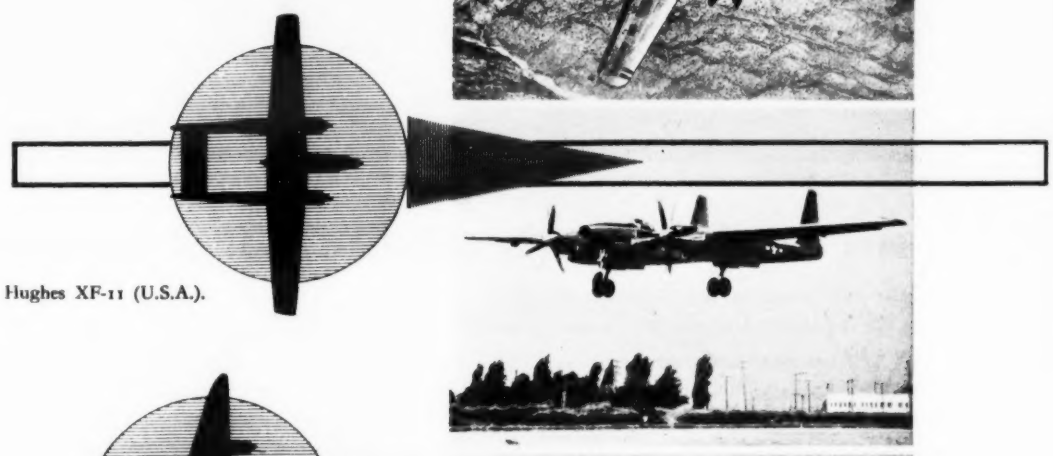
North American "Mustang" (reconnaissance version designated F-6)
Vickers-Supermarine "Spitfire" (P.R. XIX among others)
Hawker "Fury"
De Havilland "Hornet" (P.R. II)
De Havilland "Mosquito" (P.R. 34 among others)
Lockheed "Shooting Star" (F-14 or FP-80A)
Gloster "Meteor IV"
Boeing "Flying Fortress" (F-9)
Boeing "Superfortress" (F-13A)
Avro "Lancaster"

A particularly extensive job of reconversion was made on the Northrop P-61 "Black Widow" three-seater night fighter, resulting in the F-15A "Reporter" two-seater long-range reconnaissance aircraft. The remaining types mentioned above have already been described in earlier articles of this series.

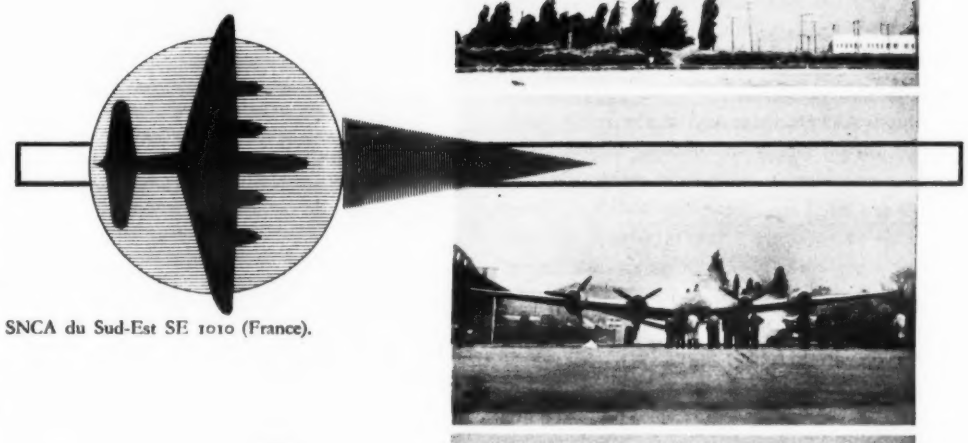
However, there do exist a number of types which were specially designed for photo-reconnaissance work, thus warranting their special mention in this list. Apart from the "Reporter," all these types are still in the test stage. Maximum speeds from 350 m.p.h. to over 450 m.p.h., ceilings of 34,000 feet upwards, and ranges up to 5,000 miles show clearly that these definitely do not concern second-quality aircraft. The reason is obvious. In times of war—and also of peace, but not so much noise is made about this—such aircraft have to operate at great altitudes without being noticed, and have to possess sufficient speed to elude eventual pursuers. The SE 1010, of which SNCA du Sud-Est are building ten units for the French National Geographical Institute, will be able to fly from one continent to another, and be more or less independent of a specific home base. Thanks to its exceptional range and elaborate interior equipment—leisure quarters for crew and scientists, dark room, stock room for spares, etc.—it will possess a degree of freedom seldom associated with aircraft hitherto. Although the performance demanded of these purely photo-reconnaissance aircraft is very high, requirements as regards payload, installation of armament, etc., and even economic factors, are exceptionally modest. The result is creations which, viewed externally, are pleasing to the eye, but which can also provide valuable indications for the design of commercial and military aircraft.



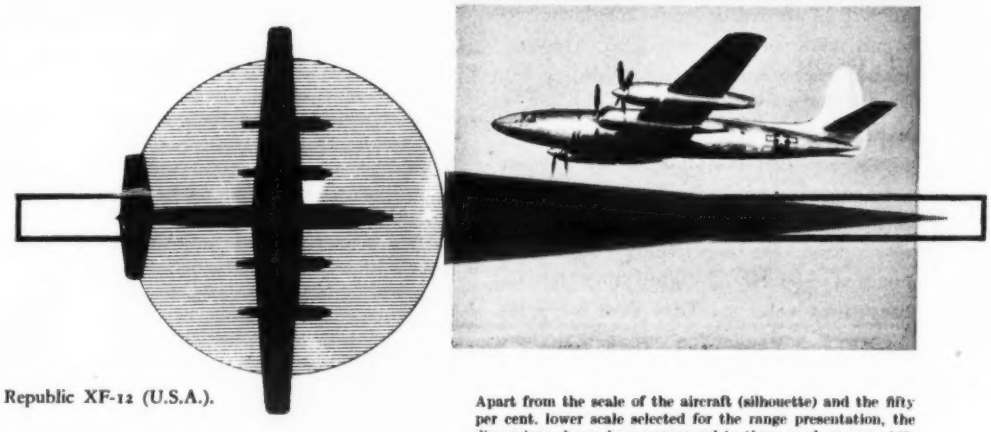
Northrop F-15A "Reporter" (U.S.A.).



Hughes XF-11 (U.S.A.).

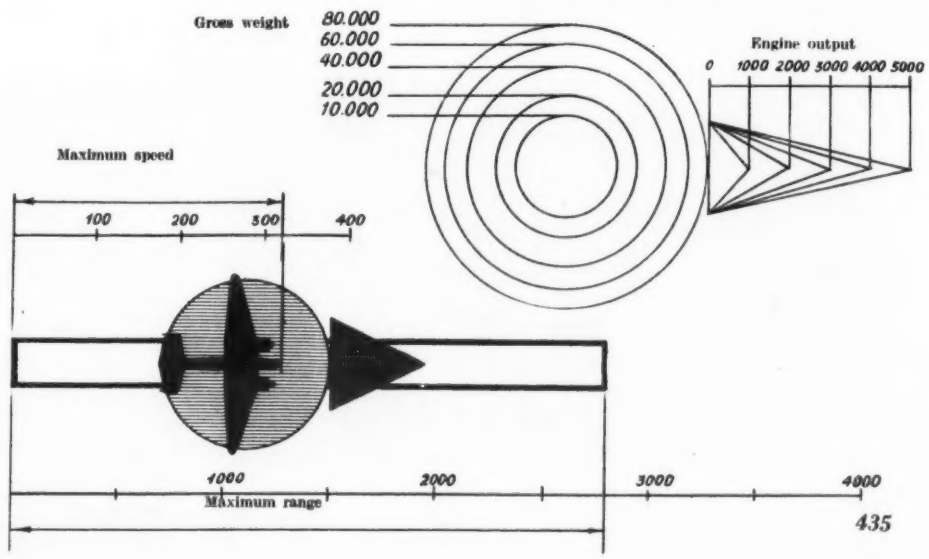


SNCA du Sud-Est SE 1010 (France).

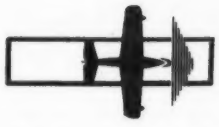


Republic XF-12 (U.S.A.).

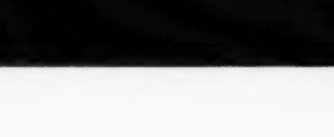
Apart from the scale of the aircraft (silhouette) and the fifty per cent. lower scale selected for the range presentation, the dimensions shown here correspond to those used on page 430.



Search and Photo Reconnaissance Aircraft



Edo XOSE-1 (U.S.A.).



Curtiss SC-2 "Seahawk" (U.S.A.).

These two pages are devoted to mentioning briefly a number of aircraft types which could not be rightly placed in the categories dealt with so far.

If he wishes quickly to find out what is going on in a restricted combat sector, over which no other air operations are taking place just at that moment, a commanding officer will usually assign the reconnaissance mission to any fighter or light bomber which happens to be available, if the sector is over land or in coastal waters. There are scarcely any aircraft left today, which are designed specifically for scouting missions. A special case, however, is presented by the necessity for short-range reconnaissance on the high seas. For this purpose, aircraft have to be catapulted from cruisers and be able to land on water. For such duties, the U.S. Navy possesses a couple of one-to-two seater types equipped with a central float : the Curtiss SC-2 "Seahawk," whose single-seater SC-1 version proved its utility during the war in the Pacific and which can also be fitted with landing wheels for operation from aircraft carriers ; and the less powerful Edo XOSE, which is at present being tested.

Meanwhile, another type of aerial reconnaissance which is gaining importance—and not only in the military domain—is aerial photography and survey. Gone are the times when, for such duties, just any kind of aircraft could be used, in which the pilot was accompanied by an observer working a portable camera. The elaborate camouflage methods perfected during the War, and the peacetime progress in survey technique, call for extremely accurate and versatile photographic equipment, which can only be installed in special designs of aircraft—eventually in place of the armament.

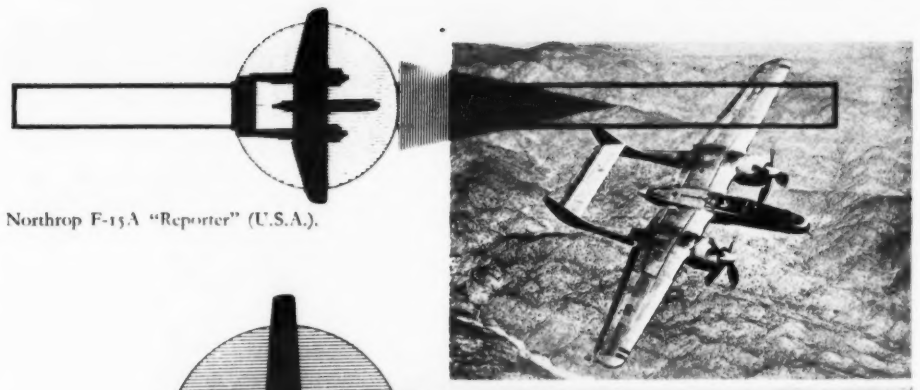
Country	Manufacturer	Designation	Crew	Power Plant	Max. power H.P.	Dimensions: Span ft. in.	Dimensions: Length ft. in.	Dimensions: Wing area sq. ft.	Weights: Gross weight lbs.	Weights: Wing loading lb./sq.ft.	Weights: Power loading lb./H.P.	Performance: Speed m.p.h.	Performance: Service ceiling ft.	Performance: Range miles
U.S.A.	Edo	XOSE-1 XOSE-2	1 2	1 × Ranger V-770-8	550	38'	31' 1"	237	....	....	....	200+	....	1,000+
U.S.A.	Curtiss	SC-2 "Seahawk"	2	1 × Wright "Cyclone 9"	1,425+	41'	36' 5"	....	....	....	....	250+	28,000	650+
U.S.A.	Northrop	F-15A "Reporter"	2	2 × P & W "Double Wasp"	5,600	66'	50' 3"	664	28,000	42.3	5.0	440+	35,000+	4,000+
U.S.A.	Hughes	XF-11	2	2 × P & W "Wasp Major"	6,000+	101' 5"	65' 5"	983	58,300	59.5	9.7	420	44,800	5,000
France	SNCA du Sud-Est	SE 1010	6+	4 × SNECMA 14 R	6,320	101' 9"	71' 6"	1,251	66,000+	52.8	10.4	350	34,400	4,500
U.S.A.	Republic	XF-12	7	4 × P & W "Wasp Major" with exhaust turbo-jet	12,800+	129' 2"	93' 10"	1,640	101,400	61.9	7.9	450+	44,000	4,500

As regards British and American fighters and bombers which have been re-equipped for this purpose, mention can be made of the following :

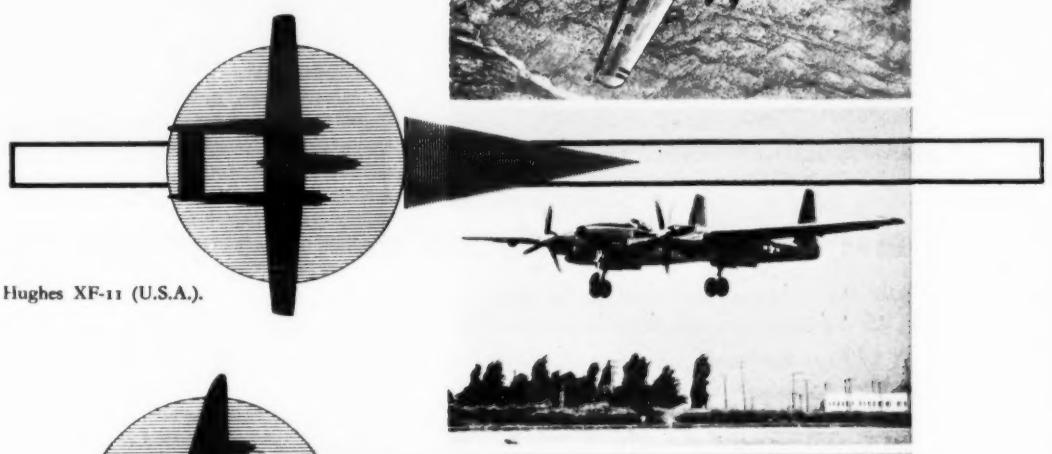
North American "Mustang" (reconnaissance version designated F-6)
Vickers-Supermarine "Spitfire" (P.R. XIX among others)
Hawker "Fury"
De Havilland "Hornet" (P.R. II)
De Havilland "Mosquito" (P.R. 34 among others)
Lockheed "Shooting Star" (F-14 or FP-80A)
Gloster "Meteor IV"
Boeing "Flying Fortress" (F-9)
Boeing "Superfortress" (F-13A)
Avro "Lancaster"

A particularly extensive job of reconversion was made on the Northrop P-61 "Black Widow" three-seater night fighter, resulting in the F-15A "Reporter" two-seater long-range reconnaissance aircraft. The remaining types mentioned above have already been described in earlier articles of this series.

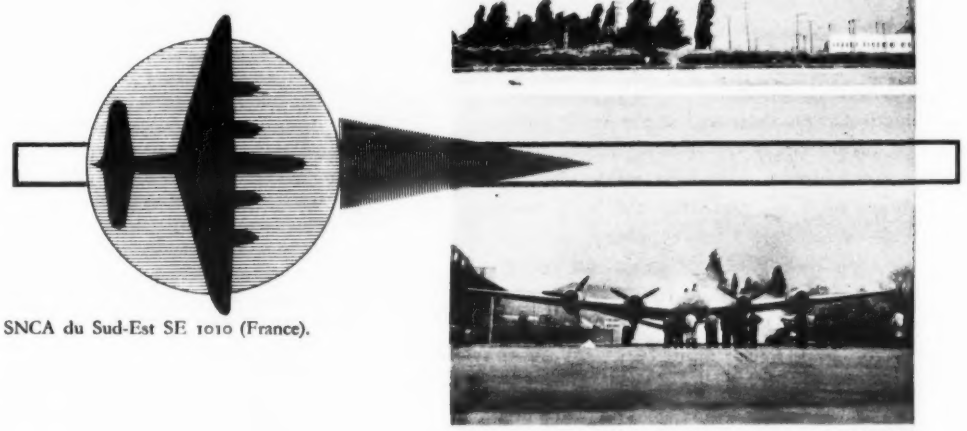
However, there do exist a number of types which were specially designed for photo-reconnaissance work, thus warranting their special mention in this list. Apart from the "Reporter," all these types are still in the test stage. Maximum speeds from 350 m.p.h. to over 450 m.p.h., ceilings of 34,000 feet upwards, and ranges up to 5,000 miles show clearly that these definitely do not concern second-quality aircraft. The reason is obvious. In times of war—and also of peace, but not so much noise is made about this—such aircraft have to operate at great altitudes without being noticed, and have to possess sufficient speed to elude eventual pursuers. The SE 1010, of which SNCA du Sud-Est are building ten units for the French National Geographical Institute, will be able to fly from one continent to another, and be more or less independent of a specific home base. Thanks to its exceptional range and elaborate interior equipment—leisure quarters for crew and scientists, dark room, stock room for spares, etc.—it will possess a degree of freedom seldom associated with aircraft hitherto. Although the performance demanded of these purely photo-reconnaissance aircraft is very high, requirements as regards payload, installation of armament, etc., and even economic factors, are exceptionally modest. The result is creations which, viewed externally, are pleasing to the eye, but which can also provide valuable indications for the design of commercial and military aircraft.



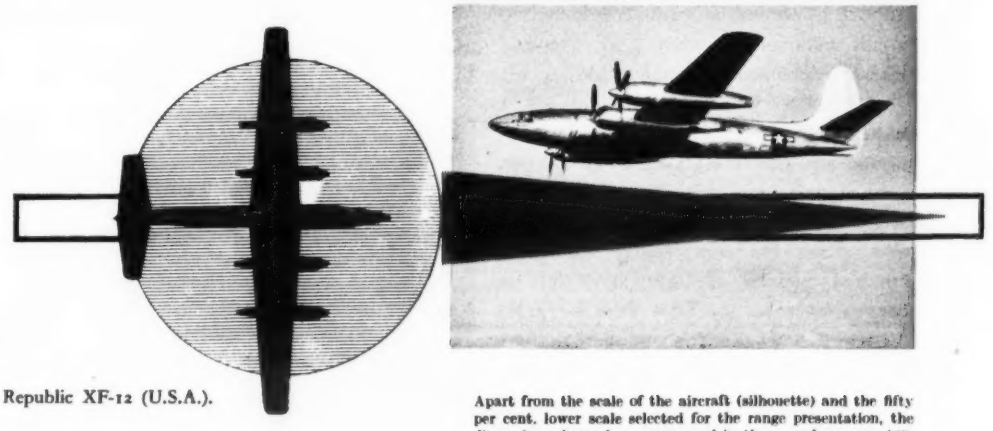
Northrop F-15A "Reporter" (U.S.A.).



Hughes XF-11 (U.S.A.).



SNCA du Sud-Est SE 1010 (France).



Republic XF-12 (U.S.A.).

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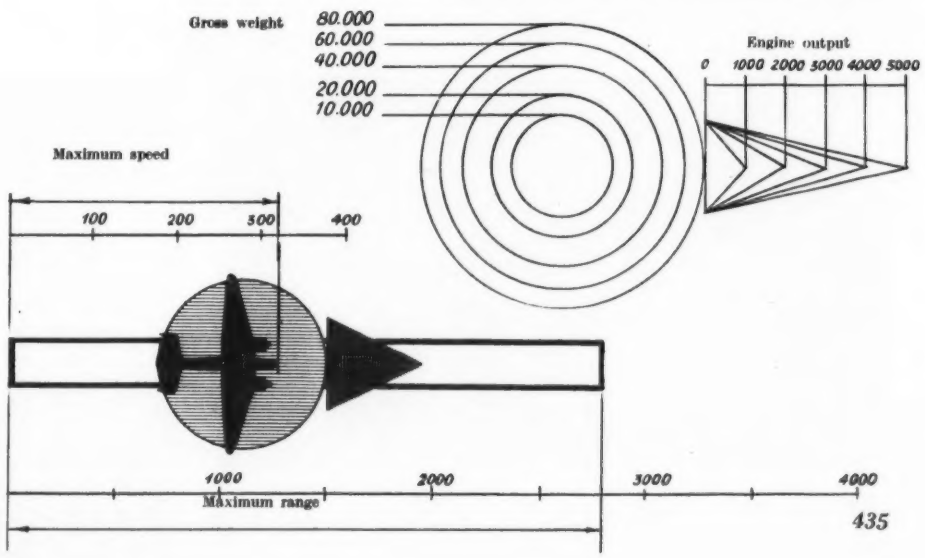


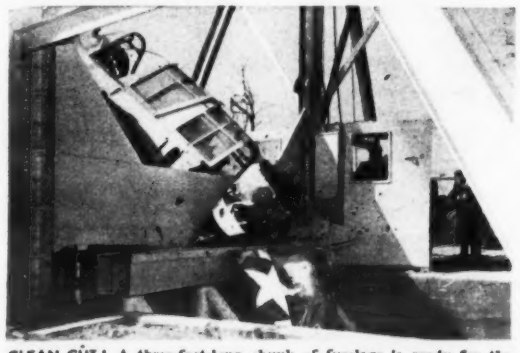
MOUNTAINS OF OLD WAR PLANES are condemned to the scrap heap; engines and all usable equipment are removed previously. In the background are metal containers under construction for the purpose of "moth-balling" Navy planes for future use.

Aircraft Construction - in reverse

What has happened to the 300,000 planes built by the U. S. aircraft manufacturing industry during the War ? Though a great many of them, in payment for victory, were destroyed in the battle areas, or during supply and training flights, about 100,000 aircraft were recoverable after the War ; of these, the Army and Navy were able to use only a few thousand, in order to keep their shrunken ranks in training. Another few thousand could be "moth-balled" and stored away. The remainder were stamped "war surplus" ; what cannot be sold must be scrapped.

Aircraft surveyed for scrapping are first stripped of all usable equipment, including engine, radio and electronic gear, tyres and other miscellaneous equipment. As regards what remains, however, it is not just a matter of 'phoning a scrap dealer to call around and cart everything away. When these aircraft were built, designers thought of many things, but not of providing an easy means for compressing those few hundred pounds of light alloy into a convenient volume. They were far more concerned with carrying out their designs with the least possible amount of material, simultaneously obtaining maximum strength. In consequence, the military salvage authorities are faced with the difficulty of handling bulk rather than weight—commodities which cannot easily be transported and are even difficult to cut up into small sections.

A BULLDOZER PUSHES A PLANE UNDER THE GUILLOTINE. The 6,100-lb. blade, hoisted electrically, will crash from a height of 26 ft.



CLEAN CUT ! A three-foot-long chunk of fuselage is ready for the smelting pot. The guillotine can cut up a fuselage in about 30 minutes, while the burning method requires eight hours.

Many salvage centres attempted the tedious task of cutting up, inch by inch, obsolete aircraft with acetylene welding equipment. But the progress was unbearably slow. However, engineers of the Public Works Department of the Naval Air Station, Norfolk, Virginia, decided that something ought to be done about it. As a result, they have built an "aircraft guillotine," much the same as the French model, but having a blade comprising two thicknesses of two-inch armour plate, and weighing 6,100 lbs. Bulldozers push the aircraft into position, and each time the knife falls, a three-foot-long chunk of fuselage or wing falls into the "basket." The resulting sections are easily removed and dropped into the smelting pots.

Here they are heated to about 1,550 deg. F., just hot enough to melt the aluminium and burn out the impurities. The molten aluminium is then poured into molds, and about 30 seconds later, 17-lb. ingots, about 92 per cent. pure aluminium, are cool enough to be taken out. Strong as the temptation might be, to be poetical and say that new aircraft are resurrected from this aluminium, the unromantic fact of the matter is that this metal's fate is rather to be compared with that of veteran war pilot who, having doffed his uniform, has resumed the "joys" of married life : a large majority of these ingots crop up again as washing machines, pots and pans ; for only the best and purest of alloys, of which the composition is known for sure, can be used for aircraft construction. *Sic transit* . . .

THE MOLTEN ALUMINIUM IS POURED INTO MOLDS, and 30 seconds later, 17-lb. ingots can be turned out. Sixteen aircraft "carcasses" a day are turned into about 1,200 marketable ingots.

TAKING THE INVENTORY. About six to eight aircraft, melted down, are represented by each one of these piles. Aluminium salvaged each month at the Norfolk Air Station fills twenty to thirty railroad cars.

The Behaviour of Runway Surfaces

By Ernst ZIPKES, D.Sc., Zurich

Since highways and runways are subjected to stresses which are different by nature, it is understandable that their surfaces, too, should be designed along different lines. Alongside the structure of the surface layer and the characteristics of its constituent materials, it is the geometrical texture of a runway surface that has the greatest effect on its general behaviour.

Mechanical compaction, effected by the passage of traffic over highways, is denied to runways, so that this omission must be taken into account during the actual application of the surface layer. On the other hand, the high landing speeds of aircraft, and their undercarriage loads, subject runway surface layers to stresses which normally do not occur in the case of highways.

From the constructional standpoint, the problems arising from the afore-mentioned, less favourable conditions can be solved without difficulty. The only questions concern the extent to which the structure of the runway surface thus obtained, meets the demands of safety—in this instance the operational safety during landings and take-offs—and in what manner the behaviour of such a surface may be assessed and controlled.

In addition to helping to solve problems on the development and execution of bituminous runway surfaces, studies which the Highway Construction Department of the Swiss Federal Institute of Technology had to carry out on an experimental runway at the new Zurich-Kloten airport also contributed towards the solution of the above questions. To elucidate these aspects is the object of the present article.

Clarity reigned from the start as to the fundamental nature of these studies, which were devoted to comparing runway surfaces, so that it was not necessary to provide for the incorporation of each particular result in the construction of Kloten's forthcoming runways. The tests were therefore extended to embrace a large number of specimen surfaces, including bituminous types and such composed of concrete slabs. Under the direction of the F.I.T. Highway Construction Department, a beginning was made with six bituminous surface layers of different structure, with thicknesses, including stone or pebble foundation, varying between 20 and 34 centimetres; the thickness of the bituminous layers varied between 5.1 and 14.4 centimetres (cf. Fig. 1). For testing various types of surface dressing, parts of these surfaces were subjected to five different treatments. The result was eleven different surfaces. Of these, the two dressed with coarse chippings (specimens Ib and IIIb) may be eliminated since they were never intended as runway surfaces.

In addition, there were five other test surfaces, made up of concrete slabs. Each of these was finished differently: three of them were treated with rubber, wooden and steel screeding boards; one was thoroughly washed by rain, and the other was sprayed with bitumen emulsion whilst its surface was still moist.

The nine bituminous specimen surfaces remaining to be tested can be grouped, according to their types of construction, as follows:

a) No surface dressing (nsd)
macadam surface (Ib, IIb)
bituminous mortar surface (Ia, IIa, IIIa)

b) Surface dressing (sd)
bituminous filler and chippings, or bituminous filler (Ia, IIIa, IIb)
course chippings (IIa)

Specimen Ia, 3 × 7.3 m. Hard chippings with sand. Surface dressing over one half, of bitumenised hard-stone filler and 1/3-mm. chippings. U.S directives for aprons and taxiways.

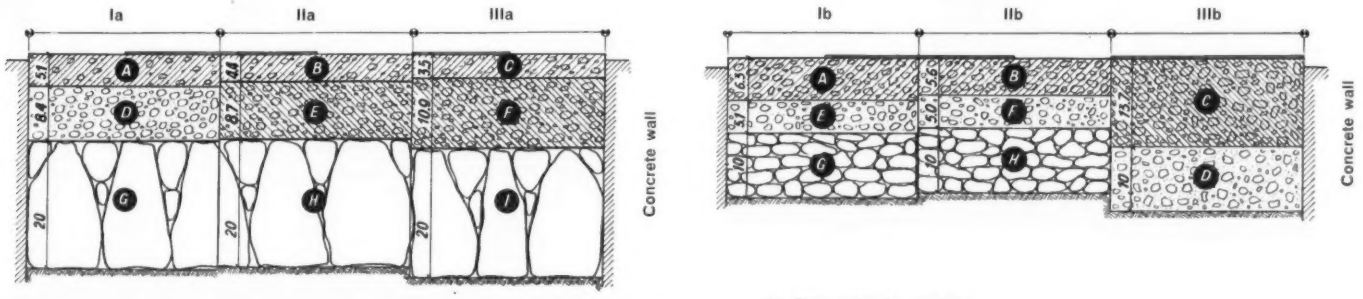
Specimen IIa, 3 × 7.5 m. Crushed gravel with sand. Surface dressing over one half, of chippings. U.S. directives for taxiways.

Specimen IIIa, 3 × 7.5 m. Hard chippings with bituminous filler. Surface dressing over one half, of bituminous filler brushed in.

Specimen Ib, 3 × 7.5 m. Crushed gravel with sand. Surface dressing over one half, of chippings.

Specimen IIb, 3 × 7.5 m. Hard chippings with bituminous filler. Surface dressing over one half, of bitumenised hard-stone, filler and 1/6-mm. chippings.

Specimen IIIb, 3 × 7.5 m. Two layers of crushed gravel. Total surface dressing of chippings.



Cross-sections of bituminous specimens. Surface thicknesses in millimetres.

A) Bitumenised fine chippings
B) Bitumenised fine chippings
C) Bitumenised fine chippings
D) Water-bound macadam
E) Impregnated macadam
F) Bitumenised macadam with crushed gravel
G) Rolled stone bed
H) Rolled stone bed
I) Rolled stone bed

A) Bitumenised macadam
B) Bitumenised macadam
C) Bitumenised macadam with crushed gravel
D) Water-bound macadam
E) Water-bound macadam
F) Water-bound macadam
G) Rolled pebbles
H) Rolled pebbles

Figures 1 and 2 show the general installation of the specimens ; structure and composition of the separate surface layers is discernible from Figs. 3 to 29.

The fourteen surfaces were measured for roughness with a Schindler Wheel (Ref. 1) and the occurring braking forces registered. The results observed as regards the braking procedure and the magnitude of the braking force during the deceleration are expressed through the media of the coefficients of contact friction during delayed rolling ($\mu_{h\,max}$) and of skid (μ_g). The measurement results were evaluated and compared with the aid of the friction index theory (Refs. 2 and 3). In the present case the friction index is the quotient of μ_g by $\mu_{h\,max}$. The service safety of a surface, discernible here from its friction index, can be expressed by the ratio of the skid track (sharp braking) with blocked wheel to the skid track (controlled braking) with the brakes applied so that the wheel still turns, but at the skid limit ; the safety of a surface is therefore indicated by the length of the skid tracks when the braking action subjects the surface to maximum stress.

This method of evaluation, based on comparison, offers the possibility of assessing the characteristics and behaviour of the surfaces under test. The criterion for the service safety of surfaces consists, therefore, in reducing to a minimum the coefficient $\mu_{h\,max}$ and stretching the friction index as near as possible to unity. The compact and smooth surface of a runway, which has to receive its final form right from the beginning, since it acquires no later mechanical compaction, is obtained by special treatment of both hydraulic mortar and bituminous surfaces, in the latter case to give it a finer texture.

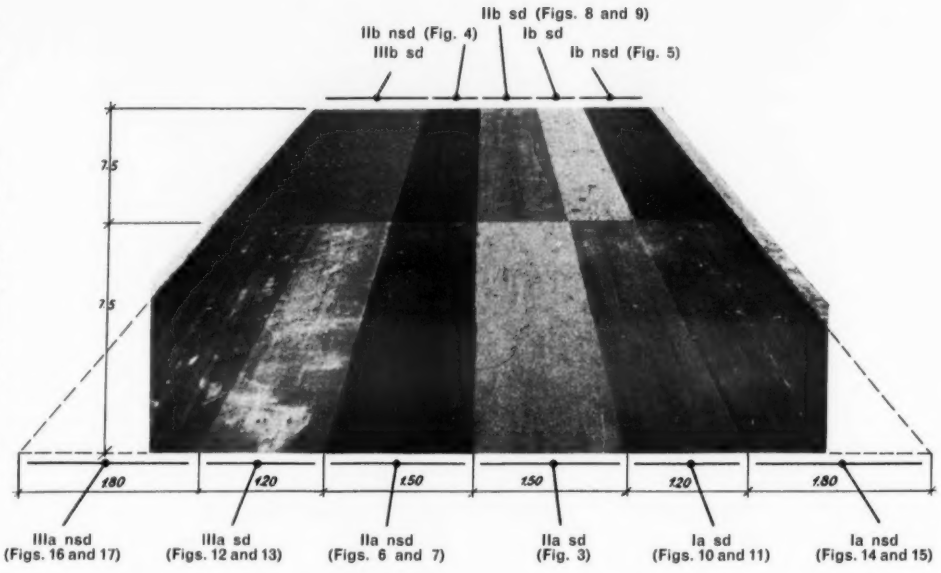


Fig. 1 : Overall view of bituminous specimens. Dimensions in metres.

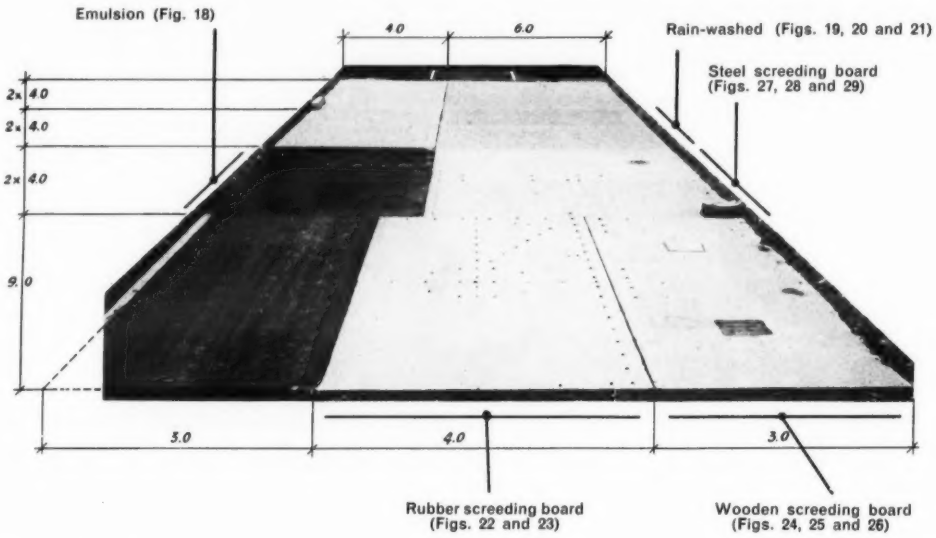
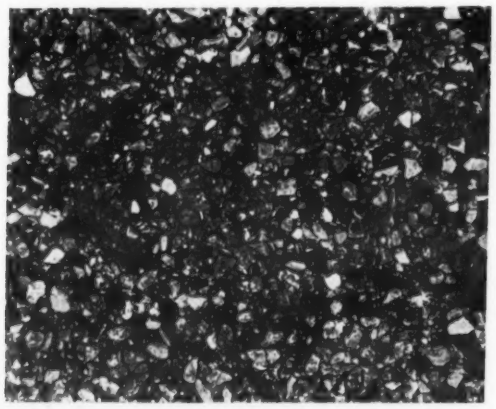


Fig. 2 : Overall view of concrete slabs of test runway. Dimensions in metres.

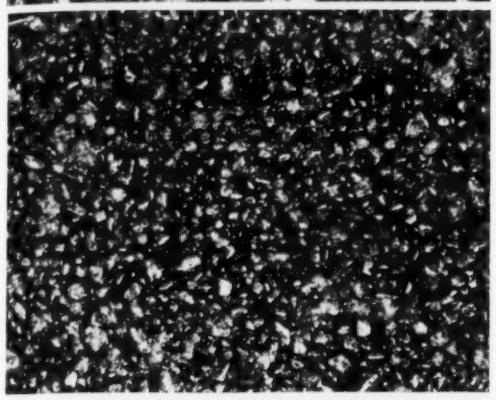
sd = surface dressing
nsd = no surface dressing

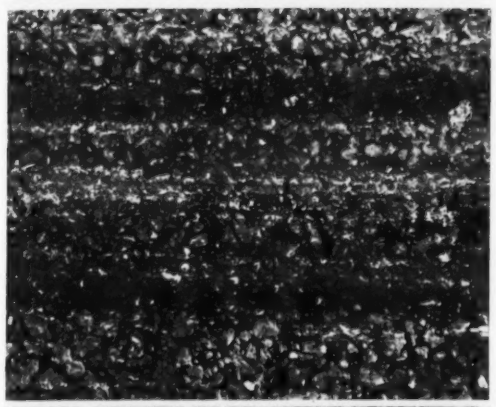
– – – – Mineral surface
–·–·– mineral with emulsion
——— bituminous surface

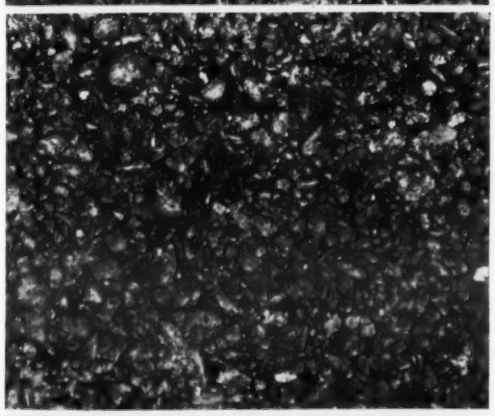
Fig. 3 : Surface of specimen IIa (bituminous mortar with surface dressing of fine chippings) ; approx. 3/4 scale.

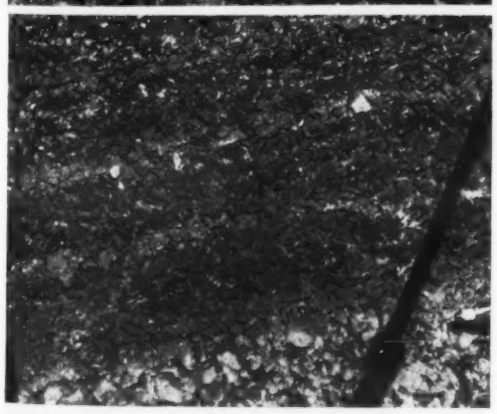


Specimen surface	Mean values $\mu_{h\,max}$	Mean values Friction index	Specimen surface	Figs.	Group	Surface characteristics
IIb nsd	0.90	0.88	IIb nsd	4	I	Bituminous surface with pre-treated filler, additional rough-edge effect provided by coarse grain or high gravel content.
Ib nsd	0.90	0.88	IIb sd	8, 9		
IIIa nsd	0.89	0.88	IIa nsd	6, 7		
Ia nsd	0.88	0.87	Ib nsd	5	II	Bituminous surface with bituminous pre-treated filler, without additional roughening effects.
Emulsion	0.88	0.87	Ia sd	10, 11		
Ia sd	0.87	0.87	IIIa sd	12, 13		
Rain	0.87	0.86	IIIa nsd	16, 17	III	Bituminous surface saturated with binder, using pre-treated filler ; or surfaces with pure binder and without pre-treated filler.
IIb sd	0.86	0.85	Ia nsd	14, 15		
IIa sd	0.82	0.85	Emulsion	18		
IIa nsd	0.81	0.85	Rain	19, 20, 21	III	Multi-edged mineral surfaces.
Wood	0.81	0.85	IIa sd	—		
IIIa sd	0.78	0.85	Rubber	22, 23		
Rubber	0.75	0.84	Wood	24, 25, 26	IV	Smoothed mineral surfaces.
Steel	0.70	0.83	Steel	27, 28, 29		









Using the accompanying table, we shall now examine the surfaces under test, and compare their structures and detrition characteristics.

The values of $\mu_{h\,max}$ are ranged in decreasing order of magnitude. In this sequence, the lowest value, " steel," is almost 22 per cent. less than the highest, pertaining to surface IIb sd. These values enable the behaviour, from the purely roughness standpoint, of the surfaces to be recognised, the main factor of influence, in this respect, being the geometrical structure in each case.

If the friction indices are presented in the same manner, the sequence of the specimen surfaces changes. If the different skid characteristics are brought into the picture, then a distinction can be made between four groups which, using the characteristics of each separate surface, enable interesting conclusions to be drawn on the construction as such.

Here it must not be forgotten that, by nature, the friction index varies between far narrower limits than $\mu_{h\,max}$ does. However, it is just this part-standardised nature of the results which enables clear conclusions to be drawn on the actual surface structure of the specimens. As regards the remainder of this investigation, no heed will be taken of the two non-dressed macadam surfaces, Ib and IIb (Figs. 4 and 5), since the open nature of their surface structure precludes their practical utility for runways.

In the first group of the table are the surfaces featuring the highest friction indices, and whose mineral constituents endow them with a certain degree of hardness, owing to the utilisation of sharp-edged, coarse-

Fig. 4: Surface of specimen IIb (macadam without surface dressing) ; approx. 3/4 scale.

Fig. 5: Surface of specimen Ib (macadam without surface dressing) ; approx. 3/4 scale.

Fig. 6: Surface of specimen IIa (bituminous mortar without surface dressing) ; approx. 3/4 scale.

Fig. 7: Same surface as Fig. 6, with skid track.

Fig. 8: Surface of specimen IIb (macadam with surface dressing of coarse, pre-treated chippings) ; approx. 3/4 scale.

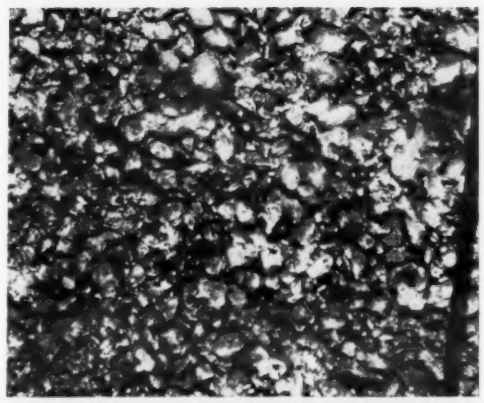
Fig. 9: Same surface as Fig 8, with skid track.

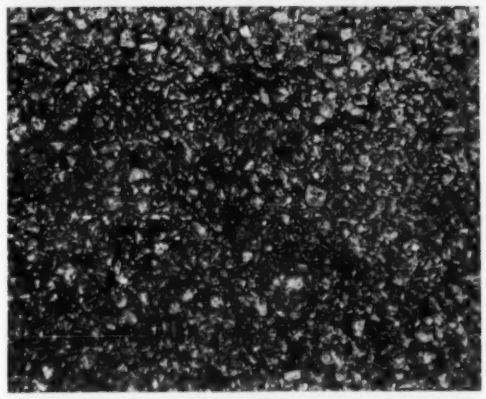
Fig. 10: Surface of specimen Ia (bituminous mortar with surface dressing of fine, pre-treated chippings) ; approx. 3/4 scale.

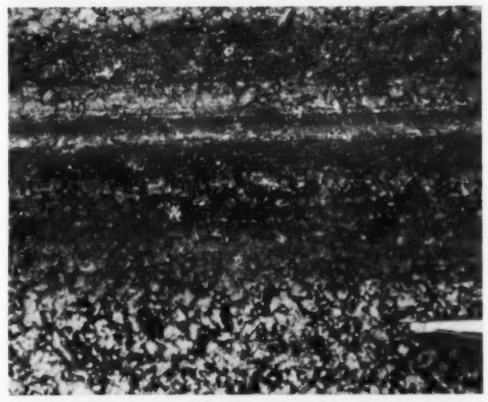
Fig. 11: Same surface as Fig. 10, with skid track.

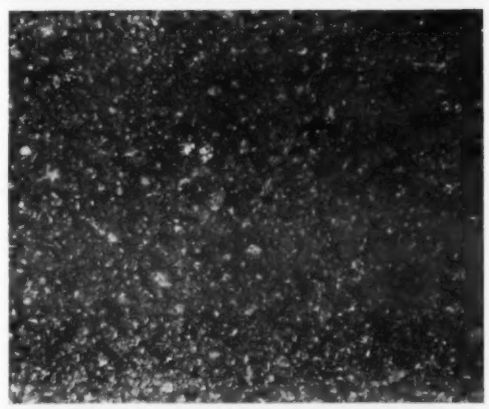
Fig. 12: Surface of specimen IIIa (bituminous mortar with surface dressing of bituminous filler) ; approx. 3/4 scale.

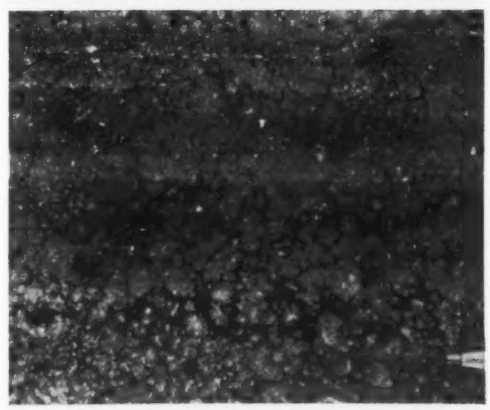
Fig 13: Same surface as Fig. 12, with skid track.

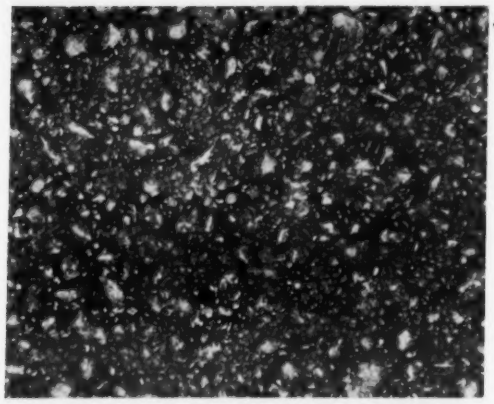












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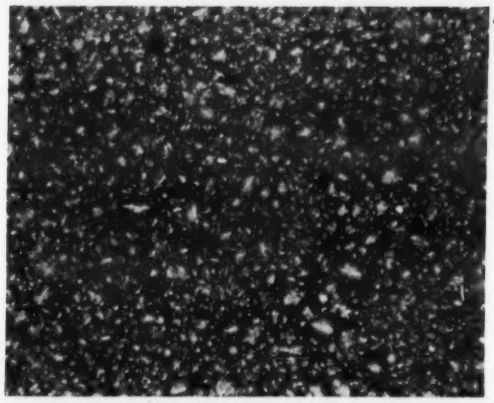

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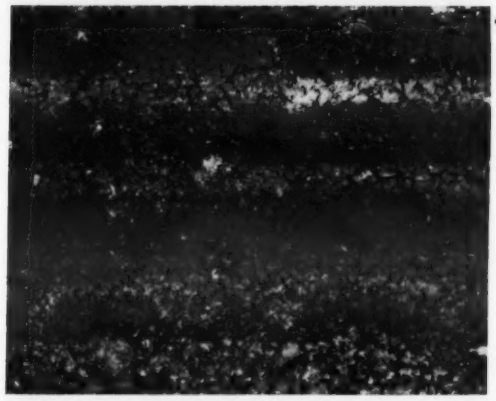

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grained aggregates. Edges and coarse grain yield an additional roughening effect, whereby the properties of the minerals, according to the shape and size of the chippings used in conjunction with the bituminous filler, play an influential part. In this group, therefore, are to be found surfaces having a high safety factor against skidding. (Specimen surface IIa nsd, Figs. 6 and 7 ; specimen surface IIb sd, Figs. 8 and 9.)

The surface shown in Figs. 6 and 7 has a high content of finely crushed gravel which, despite its unfavourable influence on the homogeneity of the surface layer, has a good effect for this type of stress. The friction index of the surface in Figs. 8 and 9 is therefore high, because it contains an extremely thin layer of 1/6-mm-grain chippings with bituminous hard-stone filler ; the advantageous effect of the more coarse particles is above all due to the circumstance that they are strongly attached to the layer immediately below and cannot be torn loose during the braking process.

The second group is comprised of surfaces whose characteristic is that they are built up of bitumenised filler, without roughening minerals. The surface of specimen Ia sd (Figs. 10 and 11) has a thin covering of pretreated 1/3-mm chippings ; the surface of specimen IIIa sd (Figs. 12 and 13) reveals a direct dressing with pure bituminous filler.

The third group embraces two types of surface, bituminous and purely mineral, which are equivalent as regards behaviour. The bituminous surfaces of specimens Ia nsd (Figs. 14 and 15), IIIa nsd (Figs. 16 and 17),

Fig. 14 : Surface of specimen Ia (bituminous mortar without surface dressing) ; approx. 3/4 scale.

Fig. 15 : Same surface as Fig. 14, with skid track.

Fig. 16 : Surface of specimen IIIa (bituminous mortar without surface dressing) ; approx. 3/4 scale.

Fig. 17 : Same surface as Fig. 16, with skid track.

Fig. 18 : Surface of concrete slab with sprayed-on emulsion. On skid mark, soft and liquified material of bituminous layer. Approx. 3/4 scale.

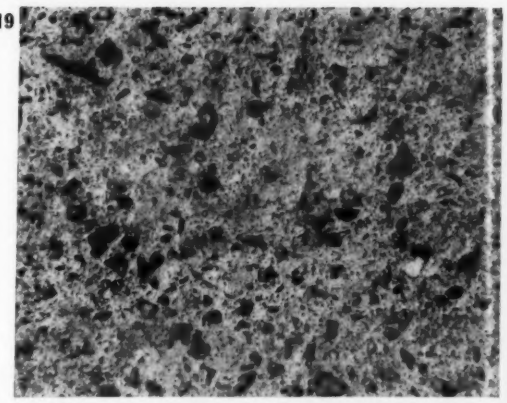
Fig. 19 : Surface of rain-washed concrete slab.

Fig. 20 : Skid track on surface of Fig. 19, with tyre detrition material (pulverised rubber).

Fig. 21 : End of Fig. 20 skid track, showing primarily concrete detrition material (Figs. 19, 20 and 21 ; approx. 3/4 scale).

Fig. 22 : Surface of concrete slab which was treated with a rubber screeding board.

Fig. 23 : Skid track on Fig. 22 surface, with rubber and cement detrition material (Figs. 22 and 23 ; approx. 3/4 scale).



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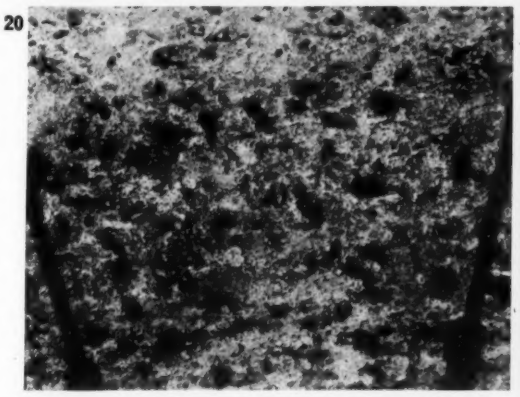

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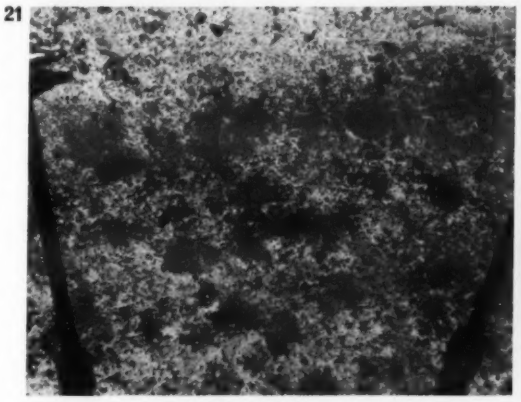

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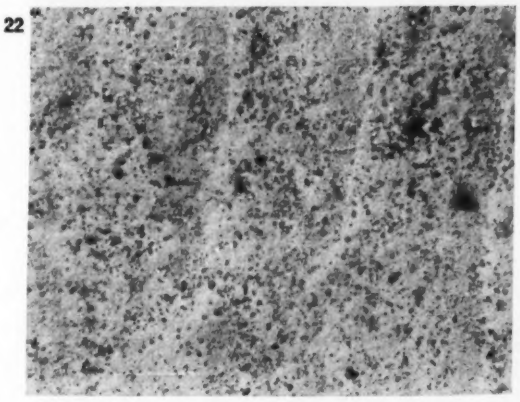

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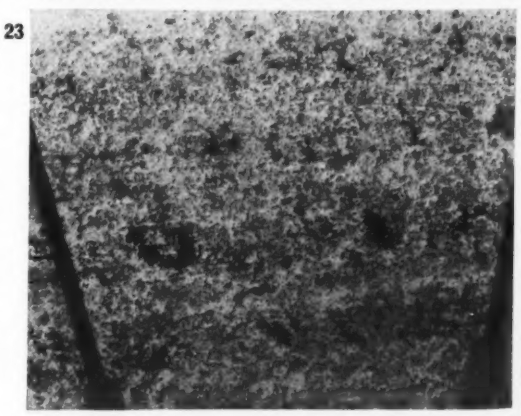

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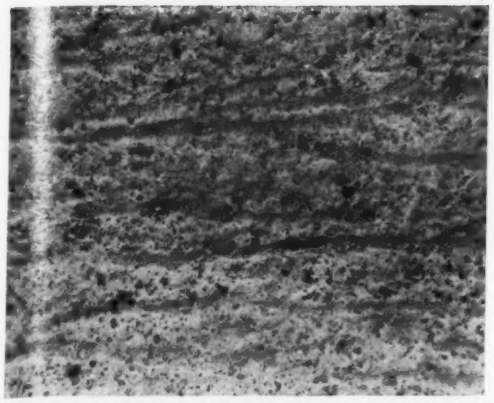

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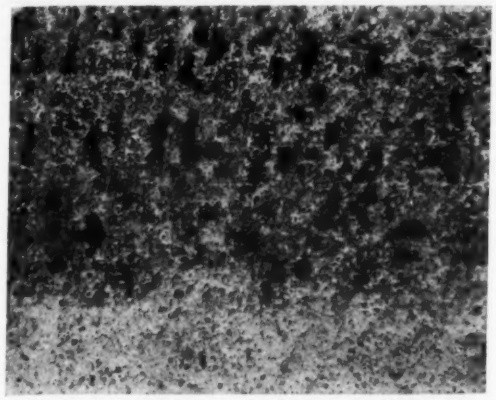

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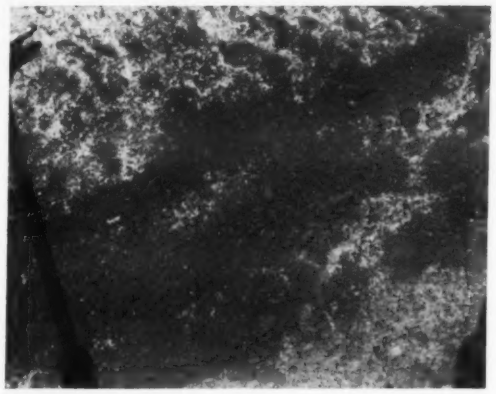

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Fig. 24: Surface of concrete slab which was treated with a wooden screeding board.

Fig. 25: Skid track on Fig. 24 surface, with tyre detrition material (pulverised rubber).

Fig. 26: End of Fig. 25 skid track, with concrete detrition material (Figs. 24, 25 and 26; approx. 3/4 scale).

Fig. 27: Surface of concrete slab which was treated with a steel screeding board.

Figs. 28 and 29: Detrition material at the end of a skid track on Fig. 27 surface, showing primarily concrete material. Figs. 27, 28 and 29; approx. 3/4 scale.

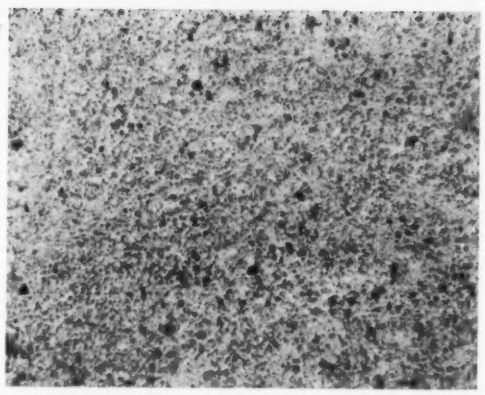
" emulsion " (Fig. 18) reveal examples of a high binding content with bituminous filler added, and one with pure binder, having no pre-treated filler. Judging by the degree of surface impermeability attained, the granular composition of specimens Ia and IIIa may be qualified as saturated, thus rich in binder, which also applies, of course, to the " emulsion " specimen. The purely mineral surfaces, the non-finished concrete slabs, " rain " (Figs. 19, 20 and 21) and " rubber " (Figs. 22 and 23), both known to be rough, have coefficients of the same order.

In the fourth and last group are the purely mineral surfaces which, in order to produce a regular, rough surface, have been artificially treated with wooden (Figs. 24, 25 and 26) and steel (Figs. 27, 28 and 29) screeding boards. In both cases, this mechanical treatment caused the liquid cement to emerge and spread regularly, thus affecting the surface behaviour as regards friction and skid characteristics.

It may appear odd that a comparison such as the one made here, could enable different surfaces to be classified so distinctly. It is again to be seen that solely the values of $\mu_{h\ max}$ allow for only a very approximate classification, which is not rendered exact until the friction indices are introduced, because only these can enable the mechanical and material processes to be assessed and sharply distinguished.

The fact that purely mineral surfaces appear, according to these results, less favourable than the bituminous types, is because, in the reaction of the forces, the influence of the mineral surfaces' roughness is diminished by material detrition caused by skid action, because the friction effect is supplemented by one of detrition. This is nothing but a confirmation of the well-known fact that two fundamentally different materials, if subjected to very close contact and made to transmit forces, will wear each other away more intensely than two less different materials will. The difference between the inter-action of rubber and hydraulic mortar materials, on the one hand, and of rubber and bituminous surfacing materials on the other, is clearly shown by the different detrition of rubber tyres on these two types of surface.

It may now be seen, therefore, that there are means available for mathematically assessing, controlling and comparing the behaviour, from the roughness standpoint, of runway surfaces. Hence it is the task of the practician to draw, in each individual case, the necessary conclusions to enable him to select the best type of surface.



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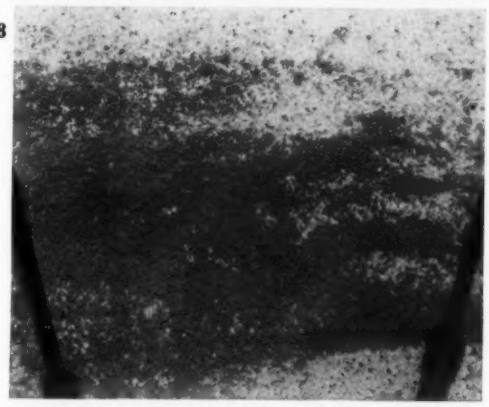

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Piloting Problems Caused by Turbo-Jets

By Bruno GUMPERT, Pau (B. P.), France.

Flying jet-propelled aircraft is so fundamentally different, in every phase, from the usual piloting technique applying to piston-engined aircraft, that one is certainly justified in examining the matter more closely, describing the piloting differences between both types of aircraft and explainingthe relevant technical causes. It is true that modern high-speed aircraft powered with reciprocating engines, in view of their high wing loading and high stalling speed, demand a great amount of caution and skill of pilots. But they are still linked with the earlier comfortable and romantic epoch of aviation, since their pilots still make an occasional zooming start or a bumpy landing. But not so the pilots of jet-propelled aircraft, for these machines take-off at an alarmingly small angle of ascent, and landings with them call for quick thought and action.

It is of course difficult to elaborate general principles for a mode of propulsion which is in an early development stage. The individual types of gas-turbine engine are still much at variance with one another. Furthermore, it is frequent that only superficial descriptions are available of many jet engines, and precise data on the main functional characteristics (*e.g.* behaviour at great altitude) are not forthcoming. It is not easy to draw general conclusions from the experiences made in flying specific types of jet aircraft, and especially not from the standpoint of magnitude. Quantitative comparisons are, however, important for understanding many of the peculiarities of jet aircraft It is for this reason that flight experiences made with a few jet and numerous conventional aircraft have been grouped here and referred to two analogous aircraft for comparison purposes :

I. *Piston-engined aircraft (hereafter called conventional aircraft)*

Power plant	2 piston engines, each of 2,200 CV take-off power, with two-speed supercharger and controllable-pitch propeller.
Wing area	40 sq. m.
Span	17 m.
Gross weight	10,000 kgs.
Maximum speed	650 k.p.h. at 6,000 m.

II. *Jet-propelled aircraft (hereafter called jet aircraft)*

Power plant	2 turbo-jets, each of 1,800 kgs. maximum static thrust, with axial-flow compressor and adjustable tail-pipe.
Wing area	40 sq. m.
Span	17 m.
Gross weight	10,000 kgs.
Maximum speed	900 k.p.h. at 4,000-6,000 m.

This provides a basis for effecting quantitative comparisons through the medium of simple diagrams. Even though the diagrams do not apply to specific types of aircraft, they do present valid principles. The two aircraft chosen as examples are fairly large twin-engined types. The conventional aircraft is about the size of a de Havilland "Mosquito" or a Grumman "Tigercat" ; the jet aircraft develops more thrust than the Gloster " Meteor, " and also features a larger wing area and a greater gross weight. The wing loading is 250 kgs./sq.m. for both types.

GROUND SERVICE

Whilst a piston engine can be started from the cockpit, without the necessity for a team of ground mechanics and special equipment, there is a marked necessity for these two features when starting up the majority of modern turbo-jets. At least a few fire extinguishers must be within easy reach, since the revving-up and ignition are frequently accompanied by spurts of burning fuel. However, improvements of the starting process will surely correct this disadvantage in the very near future. Another awkward

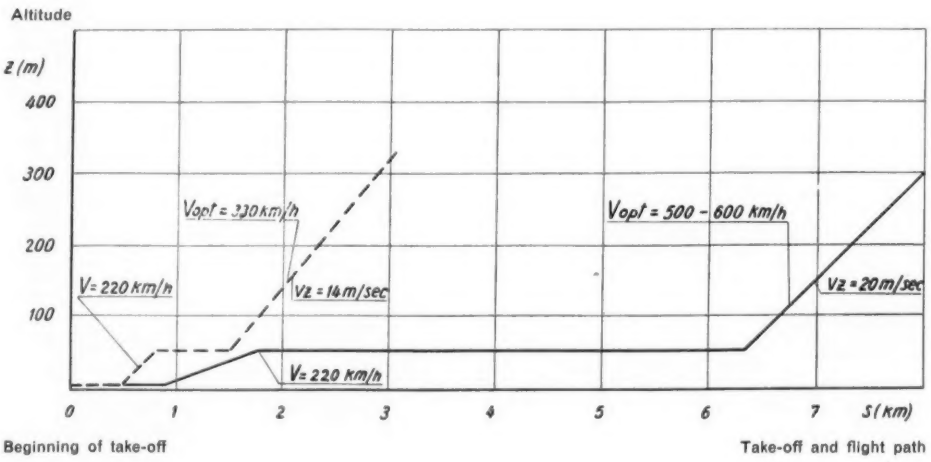


Fig. 1: Take-off progress for both aircraft

Conventional aircraft: dotted trajectory
Jet aircraft: full-line trajectory
V_{opt} = *Best speed in ascending flight*
V_z = *Rate of climb*

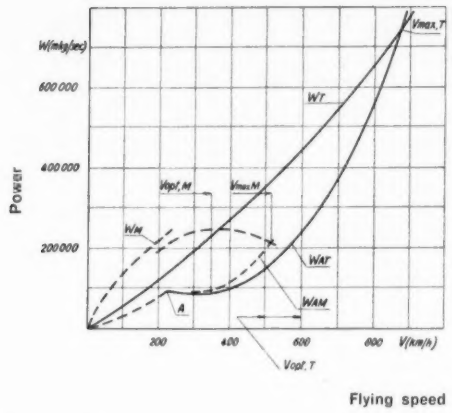


Fig. 2: Performance diagram for both aircraft; sea level ($z = 0$)
Conventional aircraft: dotted curve
Jet aircraft: full-line curve
W_{AM} = *Power absorbed by conventional aircraft in horizontal flight*
W_{AT} = *Power absorbed by jet aircraft in horizontal flight*
W_M = *Power furnished by piston engines*
W_T = *Power furnished by turbo-jets*
V_{opt} = *Best speed in ascending flight*
V_{max} = *Maximum horizontal speed*
A = *Point where airborne*

procedure is rolling the aircraft out to the runway, especially when the airfield surface is not very good. In many cases, it is therefore best to tow jet aircraft out to the runway.

TAKE-OFF

The most noticeable features of a jet air craft's take-off are the small acceleration during the first part of the take-off run, the very long take-off distance, and the small rate of ascent immediately after becoming airborne. This is shown in Fig. 1, which presents the take-offs of both aircraft diagrammatically. The diagram shows: run up to take-off speed of 220 k.p.h., ascent at same speed up to 50 m., horizontal flight (undercarriage and flaps drawn up) until speed for best climbing (330 and 500 k.p.h. respectively) is attained, and ascent. It is seen that the jet aircraft only reveals its best climbing performance once a relatively high speed is reached and after a long period of acceleration, whereas it is very " slow to react " at low speeds. In practice, of course, a pilot would not fly 6 kms. at 50 m. altitude, but would pass progressively to the best climbing speed. Meanwhile, the take-off requires a great amount of attention, especially if the terrain surrounding the airport is hilly.

The cause of this lack of power is evident from Fig. 2. At low speeds the available power reserve of a jet aircraft is much smaller that that of a conventional aircraft. This is due to the considerably lower static thrust and efficiency of a jet stream compared with that of a propeller. Even for a twin-jet aircraft, as exemplified here, failure of one engine just before or after becoming airborne always results in an abortive take-off, as the power of the other engine is insufficient to lift the aircraft. In the case of a conventional aircraft, a take-off can invariably be effected successfully on one engine, though this demands considerable piloting skill.

Accordingly, therefore, jet aircraft require obstacle-free airports with long runways. Incidentally, however, this applies equally as much to modern conventional aircraft. But if these conditions are fulfilled, then it is no more difficult to take-off with a jet aircraft than with a conventional type.

The fact that almost all jet aircraft have tricycle undercarriages aleviates the take-off considerably. It eliminates all fear of running off course during the take-off run, as well as bumpy landings. Moreover, the unrestricted forward vision and the possibility of concentrating rather on controlling the aircraft than on the actual take-off, is also agreeable.

ASCENT

It is characteristic of a jet aircraft that, even at the same wing loading, it will climb faster than a piston engine, this because of its different thrust curve (cf. Fig. 2). The conventional aircraft chosen here, attains, near to the ground and at an optimum speed of 330 k.p.h., a climbing speed of 14 m./sec., whereas the jet aircraft reaches 20 m./sec. at 500-600 k.p.h. The angle of ascent is nearly the same for both aircraft. Thus it is necessary to maintain an optimum speed for best climbing performance only in the case of the conventional aircraft ; for this, the jet aircraft has at its disposal a wider speed range, lying roughly between maximum and stalling speed for the specific altitude. As figure 2 shows, the curves for the power used in horizontal flight and the power available from the turbo-jets, are approximately parallel.

HORIZONTAL FLIGHT

Once a jet aircraft has left the ground and attained sufficient speed, it is decidedly more agreeable to pilot than a conventional aircraft. Most noticeable are the tranquillity and the absence of vibration. It may be said that, in horizontal flight, the piloting technique does not differ greatly for the two types. However, the narrow margin between the maximum and the critical speed calls for unrelaxing attention, especially during combat. Fig. 3 presents the curves of the maximum and stalling speeds at altitude. Here may be recognised the familiar dependence of the flying speed on the compressor speed for conventional aircraft, and the more even curve of the maximum speed for jet aircraft ; also the narrowing of the speed range with increasing altitude. An advisable safety measure in jet aircraft is the installation of an altitude-compensated tachyometer to prevent the upper limit from being exceeded. Likewise to be recommended is a Mach-number warning device.

FLIGHT AT CEILING ALTITUDE

Leaving aside special engines with multi-stage superchargers or turbo-superchargers, comparison shows that jet aircraft reach a higher ceiling than conventional types. This is also shown in Fig. 3.

At great altitudes, however, the special characteristics of turbo-jets—varying in accordance with the type of engine and its regulating system—are very much in evidence. Firstly, the combustion at low power can give rise to difficulties at altitudes of about 10 kms. and over, because of the low ambient temperature and pressure. Then, regulation and pulverisation of small fuel quantities is frequently not yet successful. These shortcomings can spoil the functioning of a turbo-jet to such an extent—despite an adequate performance under full power—that it is of no practical utility at great altitudes.

The ignition problem can be a further hazard to flight safety. Whereas a piston engine which has cut out can always be safely re-started at any altitude as soon as the deficiency has been repaired, such a procedure can only be carried out at low altitudes with jet engines, and even then it is not always absolutely reliable. If a turbo-jet's combustion has been interrupted as a result of carelessness on the part of the

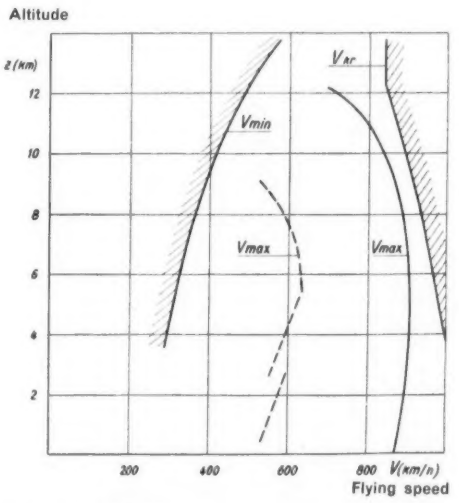


Fig. 3: Maximum and stalling speed, versus altitude z
Conventional aircraft: dotted curve
Jet aircraft: full-line curve
Danger zones: shaded (V_{kr} = critical speed)

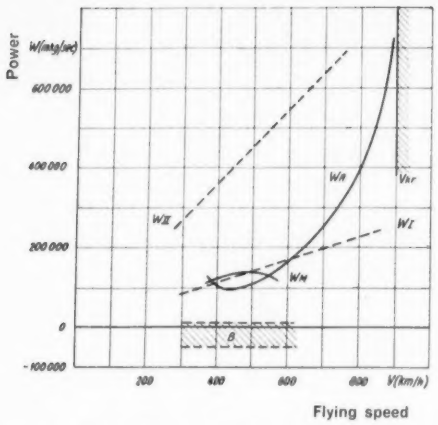


Fig. 4: Performance diagram of conventional aircraft at ceiling altitude (z = 9,000 m.)

W_A = *Power absorbed by aircraft in horizontal flight*
W_M = *Power furnished by engines (and propellers) at full r.p.m.*
W_I = *Propulsive power when idling and at angle of descent of 1 : 10*
W_{II} = *Propulsive power when idling and at angle of descent of 1 : 3*
B = *Braking range of propeller*

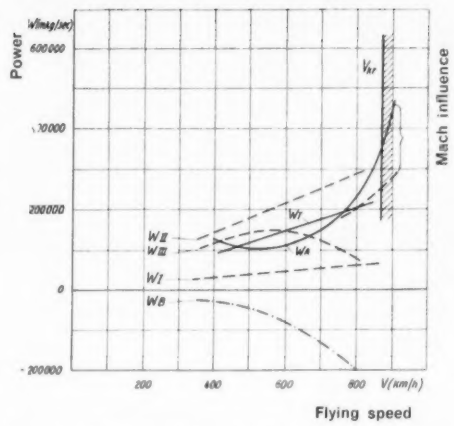


Fig. 5: Power diagram of jet aircraft at ceiling altitude (z = 11,000 m.)

W_A = *Power absorbed by aircraft in horizontal flight*
W_B = *Power absorbed by dive brakes*
W_T = *Full thrust of turbines*
W_I = *Idling thrust of turbines*
W_{II} = *Propulsive power when idling and at angle of descent of 1 : 10*
W_{III} = *Propulsive power when idling, angle of descent of 1 : 10, and flaps extended*

pilot—*e.g.* a brief closing of the fuel pipe whilst switching from one tank to another—then it is necessary to seek a low altitude in order to try firing the combustion chambers again at low flying speed. Since it is extremely difficult to land with one engine cut out, or even to effect a forced landing, this can represent a real danger to the aircraft and pilot.

A further difference from the reciprocating engine concerns the idling power, and this is particularly prominent during descents at great altitudes. In this position, the propeller-engine normally has only a slightly positive idling thrust, and frequently even a negative idling thrust. If, by suitable regulation, the propeller's idling r.p.m. can be kept high, quite a high braking thrust can be obtained. Fig. 4 shows these relations at ceiling altitude for a conventional aircraft. As can be seen, a slight inclination of the aircraft's trajectory does not represent any danger, and critical flying speeds are reached only at an angle of descent of approximately 1 : 3.

Conversely, in jet aircraft (Fig. 5) the idling thrust always remains positive, and almost constant no matter what the flying speed is ; the power therefore augments with the speed. In view of the small frontal drag, idling power and an angle of descent of about 1 : 10 suffice to reach the critical Mach number very quickly.

However, every sudden approach—often not even noticed—towards the critical speed, signifies danger, and has already caused many accidents. A pilot, especially in a single-seater aircraft, has to focus his attention on many items : navigation, radio communications, controlling the engine and fuel supply, etc. Even the flight mission, as such, demands his full attention. Besides this, his powers of reaction, despite his oxygen mask, are doubtlessly lessened at altitudes of eleven kilometres and more. It can then easily happen that a pilot does not observe his instruments for a brief instant, and allows his machine to descend a little steeply. Suddenly he notices an increasing tendency towards nose-heaviness, and that he must make an abnormally great effort to operate the control surfaces. In such a case, it is a question of lightning reaction and great muscular strength, whether he will succeed in righting his machine.

DESCENT

In view of the high idling power and the good aerodynamic quality, jet aircraft descend very slowly from great altitudes. However, a higher rate of descent is necessary for safety reasons, for both military and civil designs. The theoretical possibility of decreasing the thrust by deviating the jet stream is not easily put into practice. The only solution for jet aircraft is therefore to install spoilers or dive brakes, such as those found on the de Havilland " Vampire " and the North American FJ-1. Fig. 5 shows the power absorption and the efficiency of a dive brake. A better solution could, of course, be provided by a propeller-turbine fitted with a reversible-pitch propeller.

LANDING

The landing procedure calls for a great amount of functional flexibility on the part of the engine, meaning a low idling thrust together with sufficient power and rapid acceleration to enable a pilot to go round again in the event of a misjudged landing. Present-day turbo-jets fulfil those conditions only partly. The idling thrust, which is generally negative and dependent on the regulating method in the case of piston engines, is always positive in turbo-jets, amounting to 5-10 per cent. of full thrust. This must be borne in mind when approaching to land. Whereas landing a jet aircraft on a sufficiently long runway is not more difficult than landing a conventional machine, faulty landings are much more dangerous. The same applies to an obstacle on the runway, which is noticed only at the last minute, or a wave-off from the deck officer on an aircraft carrier.

Thus, if an aircraft is to provide safety in landings, it must give pilots the possibility of gathering last-minute speed for going round again. For this, the feeble thrust of turbo-jets at low speeds, and the slow initial

A North American FJ-1 " Fury " carrier-borne fighter is shown here with extended dive brakes which keep the rate of descent below the critical limit. Power plant of the FJ-1 is an Allison-built General Electric TG-180A5 axial-flow turbo-jet.

acceleration from idling speed, are not advantageous. As a rule, turbines require several times as long to accelerate as piston engines do. The acceleration period, from idling to full power, can be up to 16 seconds, this being due to the feeble acceleration torque moment in proportion to the great kinetic energy of the rotating masses. Fig. 6 shows the through take-off trajectories of both aircraft, under the supposition that the decision to fly up again was taken while the aircraft was ten metres off the ground. The conventional aircraft climbs again easily, gaining enough altitude to fly over any eventual obstacles on the fringe of the airfield, whereas the jet aircraft only just succeeds in emerging from the airport area and also carries out a small, involuntary " intermediate landing " which renders the manœuvre still more difficult. This problem is therefore very serious and difficult. The only way out seems to be to land on higher thrust, *i.e.* higher engine r.p.m., with sufficiently large flaps extended to increase the drag. The engines are then throttled only just before touching down. If, however, it is necessary to fly up again, the flaps are rapidly pulled up and the full engine thrust can be utilised straight away, with the drag reduced (but with the same lift).[1]

Landing a jet aircraft with one engine cut out is still more difficult. The approach itself needs a great amount of piloting skill. Precisely in this case, the possibility of flying up again is very important. The conventional aircraft succeeds only barely in accomplishing the super power test of regaining altitude on one engine, but it is practically impossible for a jet aircraft to do the same. Below a certain speed (300 k.p.h. in the present example) the jet aircraft can no longer fly horizontally. This is all the more unpleasant, as the normal speed range for approach flight is 240-300 k.p.h. Owing to the drag of the extended undercarriage and flaps, the conditions are worse than those presented in Fig. 7.

[1] " INTERAVIA, Review of World Aviation, " No. 6, Vol. III : de Havilland " Vampire, " by W. Green (p. 343).

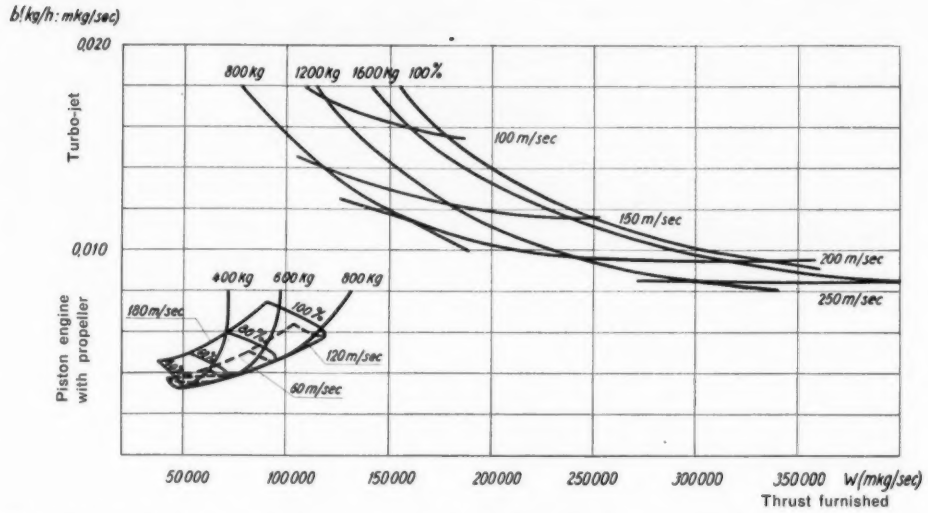


Fig. 8 : Specific fuel consumption at sea level of piston engines with propellers, and turbo-jets' versus thrust furnished

Fig. 7 : Rate of climb on one engine at sea level, versus flying speed (undercarriage and flaps up)
Conventional aircraft : dotted curve
Jet aircraft : full-line curve

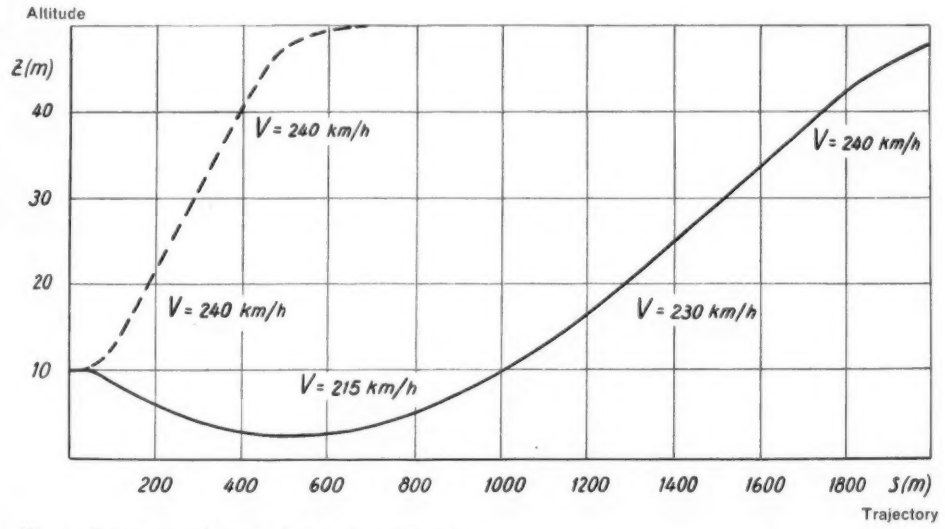


Fig. 6 : Trajectory of aircraft flying through again

Conventional aircraft : dotted curve
Jet aircraft : full-line curve

Thus it may be seen that landing a jet aircraft calls for much greater acquaintance with aircraft and engine than landing a conventional aircraft of the same wing loading and configuration.

DURATION FLIGHT AND RANGE

The paragraphs below deal only briefly with the problems occurring in long-range flight, the most important of which is the range problem. Since the theoretical aspects have already been examined in this magazine,[2] the present lines are devoted to the practical side ; an attempt is again made to clarify the differences by comparing the two aircraft with one another. The typical criterion for the range is the fuel consumption per unit of distance flown (kg./km.), to which this study will restrict itself for the sake of simplicity. It is dependent on the propulsive power, altitude and flying speed. In comparing the piston engine with the turbo-jet, either the equivalent shaft power (in CV) or the thrust furnished (in mkg/sec.) can be used as basis. The latter is chosen here.

Fig. 8 gives a means of first studying the characteristic difference between the two modes of propulsion alone, thus without the airframe. The power of the turbo-jet is clearly much superior to that of the piston engine, but this is an advantage which must be paid for with high fuel consumption. It is important to notice that the specific consumption of the turbo-jet decreases as the power and flying speed increase, whereas the piston engine acts in precisely the opposite manner. In view of the decrease in propeller efficiency at high speeds (above 650 k.p.h.), there is gradually less difference

[2] " INTERAVIA, Review of World Aviation, " No. 10, Vol. II : " Range Problems in Jet Propulsion " (pp. 40-44).

The Ryan FR-1 " Fireball, " a U.S. Navy fighter built some years ago, is powered with a reciprocating engine (Wright " Cyclone 9 " driving Hamilton Standard c. p. propeller) and a turbo-jet (General Electric I-16). It is shown here flying on jet power alone, with feathered propeller.

in specific fuel consumption between the two types of engine. But because of its smaller consumption at medium power, the piston engine is superior to the turbo-jet as regards range. Consequently, some aircraft are fitted with both piston engines and turbo-jets (Martin P4M " Mercator " patrol bomber, with two " Wasp Major " radials and two J-33 turbo-jets ; Ryan " Fireball " ; special Avro " Lancastrian " ; and so forth).

For the two aircraft shown as examples here, taking into account the aerodynamically superior airframe of the jet aircraft, the specific fuel consumption (in function of altitude and flying speed) yields the curves shown in Fig. 9. As can be seen, the speed range and fuel consumption of the jet aircraft are very high at sea-level altitude. At greater altitudes, however, the fuel consumption of the jet aircraft is considerably less, and in high-speed flight (over 650 k.p.h.) it would be about the same as that of the conventional aircraft.

Over long distances, therefore, pilots of jet aircraft should not hesitate to seek high altitudes. On the other hand, the magnitude of the cruising speed is not very important, as the consumption curves are rather flat. In view of the high consumption near to sea-level, an increased supply of fuel must be carried for landing under bad conditions, or for instrument flying.

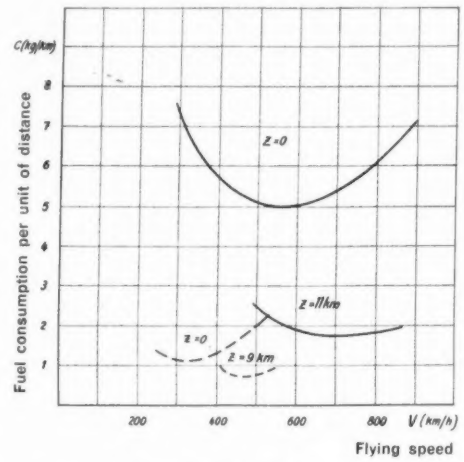


Fig. 9: Fuel consumption per unit distance (kgs./km.) of both aircraft, versus altitude and flying speed
Conventional aircraft: dotted curves
Jet aircraft: full-line curves

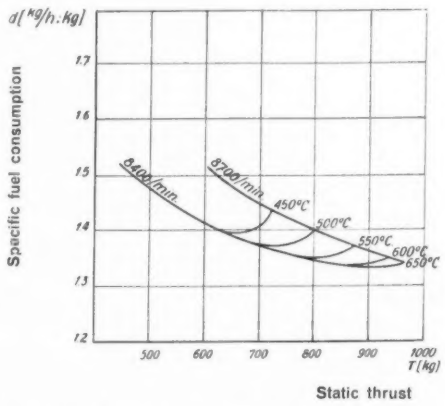


Fig. 10: Specific fuel consumption d (kgs./hr. per kg. thrust) and static thrust T (kgs.) at sea-level of an axial-flow turbo-jet with adjustable tail-pipe (Jumo 004), versus r.p.m. and exhaust gas temperature.

If a detailed study were to be made, it would be necessary to possess detailed knowledge of the engine characteristics. For example, it would be necessary to know whether the tail-pipe is adjustable, and how it is adjusted. Just as a given power and speed may be obtained in a piston engine by specifying a high r.p.m. and low boost pressure, or vice versa, a jet aircraft can be flown with high r.p.m. and low gas temperature, or low r.p.m. and high gas temperature.

When flying on instruments, particular attention must be granted to the critical speed. Great caution must be taken in flying by the turn-and-bank indicator alone, in view of this instrument's faulty indications at large-angle inclinations. It is therefore advisable to have a gyro-horizon installed.

CONCLUSIONS

It is clear that, in every phase of a flight, jet aircraft require much more attention than conventional aircraft do. The pilot must be able to think clearly and quickly ; he must be prudent and well acquainted with the technical aspects. Many of the dangers presented by this newest form of prime mover may be regarded as " teething troubles, " which will disappear as development progresses.

It is probable that turbo-jets will find general introduction only for high-speed fighters and bombers. The propeller-turbine seems to be the more suitable type for civil aircraft. It provides a slightly lower speed, but compensates with superior take-off and climb performance, and considerably better manœuvrability. There are still a number of problems to be solved in connection with regulating systems for propeller-turbines. The solutions are so clearly possible, however, that it is only a matter of time before such engines will be able to switch rapidly and progressively from full positive thrust to maximum negative thrust, at all altitudes and at all flying speeds. And it is gratifying to know that all leading engine firms, as well as many component manufacturers, are working non-stop to develop and perfect aircraft gas turbines.

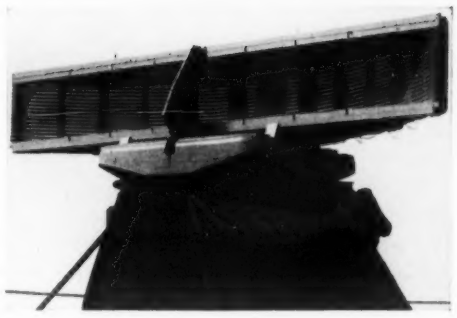
Radar for Airports

The last issue of this magazine contained an article describing a lavish American programme to organise a " total " airway control system.[1] Projected by the Radio Technical Commission for Aeronautics, this plan provides for extensive automatisation of navigation and traffic control procedures so that pilots of all aircraft traversing the U.S. air space will be able to keep accurately to predetermined air lanes, holding patterns, approach paths, etc., and be continually furnished with corrections on course, altitude and speed through the medium of cockpit pictorial displays and VHF telephony. It is estimated that, by the time the R.T.C.A. Programme has been fully implemented, it will be possible to have 100,000 aircraft flying between 550 airports in all weather conditions.

Even if it were supposed that this enormous traffic volume were equally distributed among all airports and all hours of the day and night, it would still denote eight arrivals and eight departures of aircraft an hour for each airport. It would furthermore signify that, at about the same moment, one aircraft would be taking off, another would have its engines running in readiness to take off, a third would be taxiing out to take the place of the second aircraft, and a fourth would just be loading its passengers or freight ; simultaneously, one in-coming aircraft would be on the approach beam (during which time others would be approaching the runway), another would have terminated its landing run and be turning down a taxiway, a third would be drawing up before the terminal building, and a fourth would be unloading its last passengers. And at the same time a number of other aircraft would be going and coming from the parking aprons, overhaul shops, and so forth.

This brings to light another complex problem, apart from that of pure airway traffic control : *the problem of controlling taxi operations on large airports.*

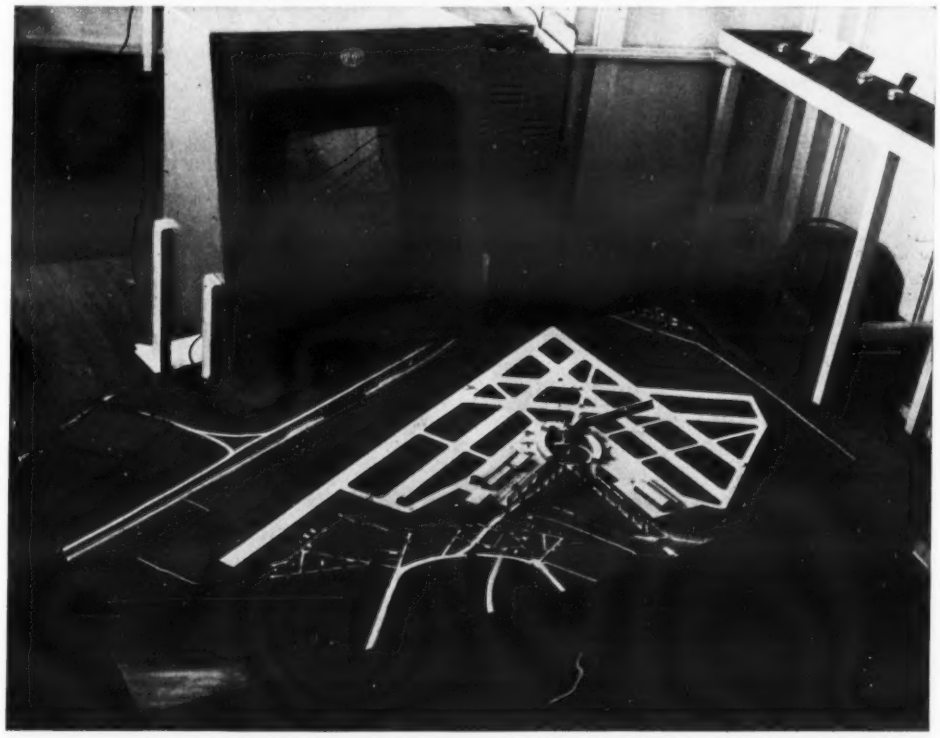
Since every chain is only as strong as its



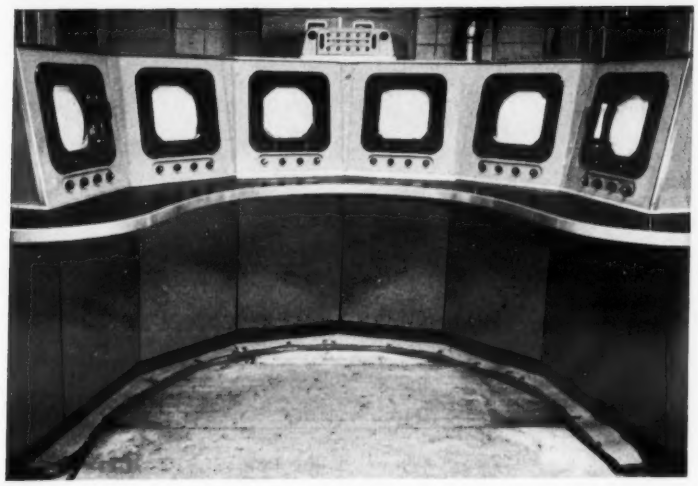
Radar scanner for surface movement indication.

weakest link, it is logical that all improvements in navigational technique, airway control, ILS and GCA, cannot raise the traffic volume above a specific level dictated by an airport's ability to cope with aircraft operations. One only needs to imagine the position the people in an airport control tower find themselves in during bad visibility conditions. Taxiing aircraft disappear into the mist after a few hundred yards. How can a controller know whether a runway is clear, or which taxiways are being used, if he cannot see a thing ? But he has to know all these details before he can authorise a take-off or a landing, or even a simple taxiing movement. True, there are strict rules and regulations to which every pilot must and usually does adhere. But there are countless examples to show that it is not enough to rely on discipline. A pilot may, for some reason or other, have interrupted his take-off run and be at a standstill or returning by a taxiway ; a tractor or fuel truck may be blocking a runway. Again, modern airports are very large and have numerous runways measuring many thousand yards, connected by a great number of taxiways ; even two or more runways may be in simultaneous use.

P.P.I. display of Sperry Airfield Surface Movement Indicator, shown with model of proposed enlargement of Melbræk Airport, Brussels. Arrow points to position of radar scanner on roof of control tower.



[1] Cf. " Interavia, Review of World Aviation, " No. 7, Vol. III, pp. 366-368.



RADAR FOR SEA-PORTS: Six P.P.I. displays for harbour supervision, belonging to equipment built by Sperry for Mersey Docks and Harbour Board in Liverpool. Cathode ray tubes are 15 inches in diameter.

In a paper published as long ago as 1946 by the British Ministry of Civil Aviation, a study was made of several suggestions for providing information on surface movements in bad visibility, amongst which were included the following :

1. The provision of a number of men disposed about the airport in telephonic contact with the control tower.
2. The use of infra-red light beams and photo-electric cells.
3. A system of microphones to pick up aircraft engine noise.
4. An elaborate system of traffic pads let into the runways and taxiways.

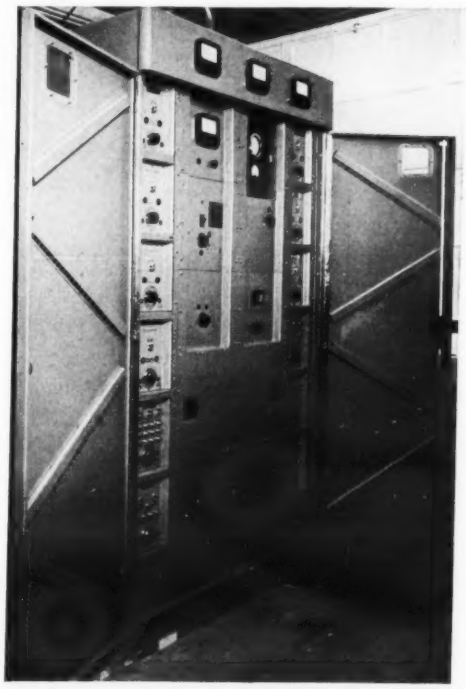
These four suggestions suffer from a number of disadvantages, the main one being that the control tower is provided with only isolated items of information ; for instance, aircraft or vehicles stopped between information points would probably not be indicated. The placing of men at all critical points along the runways and taxiways would moreover be very expensive—the men would have to be relieved frequently in bad weather—and continuous plotting of their reports would entail a good deal of labour for the control tower personnel. Microphones and traffic pads could give no information on the identities of aircraft. What the control tower needs is a comprehensive picture of the state of the airport.

The paper then accepted a fifth suggestion, which, using a form of radar scanner, offered the most promising means of surface movement indication. This involves the use of radar equipment with a very high discrimination, operating a plan position indicator located in the control tower. Whilst alone overcoming the disadvantages of the other four suggestions, the radar system was cheaper to install and to operate ; moreover, it provided a picture which could be superimposed upon a plan of the runways and taxiways, and could also furnish the identity of aircraft, thereby offering the possibility of giving them instructions by VHF telephony.

These requirements have since been largely fulfilled by an airport surface movement indicator developed by the British firm of *Sperry Gyroscope Company Limited*, of Brentford, Middlesex. A model of this equipment, based on the proposed enlargement of Mels broek airport, was demonstrated last May in Brussels, and the company hopes to show this model again at the forthcoming S.B.A.C. Display in Farnborough.

The Sperry system mainly consists of a large radar scanner sited either on the control tower or at any suitable position in the airport, and a plan position indicator located in the control tower. The P.P.I., using a large cathode ray tube of 15 inches diameter, and the radar scanner, can be separated by a distance of even a mile or so, if local conditions demand it. In front of the tube is an illuminated map of the airport, showing runways, taxiways, aprons, etc., so that the position of any object featured on the indicator is given without lengthy measurement. Whilst the P.P.I. display is highly accurate and altogether free from distortions, it is conceived in a way that the point of rotation of the trace can be moved to any part of the screen or even off the screen ; thus if it is necessary to site the radar antenna on the fringe of the airport, the picture of the airport can be displayed centrally on the screen without wasting space. In the case of extremely large airports, more than one P.P.I. display can be provided, and adjusted to show different parts of the airport to a large scale, instead of having to crowd the entire picture on to one screen.

Transmitter-receiver of Liverpool installation uses 3 centimetre VHF.



A similar radar system, but featuring six P.P.I. displays, has been built by the Sperry company for indicating surface movements over a radius of twenty miles in the Liverpool harbour area. Also using 15-inch cathode ray tubes, one shows a complete plan picture of the area, each of four others a true-plan picture of a sector to an enlarged scale,and the sixth, a wandering display, can be switched on to any desired section of the harbour area. The accompanying photographs show one of the scanners, a three-centimetre transmitter-receiver with its semi-circular search antenna which has a bearing discrimination of 2/3 deg. and a range discrimination of 40 yards.

The Sperry surface movement indicator, in its present form, represents a transitional stage. The R.T.C.A. Programme provides for a transmission of the airport situation from the tower display screen to a cockpit screen inside every aircraft. Until this is accomplished, however, much will have to be done to develop both suitable ground and airborne equipment. *Ri.*

Position and Development of World Air Transport

BY C. PIRATH, D.Sc.

It is not easy for a German aeronautical expert to assess the present-day position of world aviation. He finds himself assigned the rôle of a spectator who lost contact with the organisational development of international civil aviation in 1939, if not earlier.

On the other hand, however, this forced passivity can give rise to a certain degree of objectivity, provided he has the requisite theoretical tools and the good will. The account rendered below is not lacking in this respect. And we may add that the name of Professor Pirath, Principal of the Transport Department of the Stuttgart Technological Institute, is sufficient guarantee for the impartiality of this article.

The Editor.

I. Goal and Limits of the Study

If the position and development of world air transport is to be studied from inside Germany, it can only be done with a certain reserve : a reserve which not only defines the meaning and goal of the study, but also its limits.

This reserve arises from the fact that Germany has been assigned the rôle of a mere observer as regards all international transportation, and also, therefore, as regards the latter's youngest and most promising branch, air transport. Any essential transport activity beyond the national frontiers is forbidden to her. As regards civil aviation, this limitation extends much further : by the terms of Control Council Law No. 2, even within the national frontiers, any civil aviation activity, be it concerned with the manufacture, ownership, maintenance or operation of aircraft of any kind, is forbidden to Germany.

The new intention of the Occupational Powers, to connect Germany with the airline networks of Europe and the rest of the world, has given a positive side to this passive relation of Germany to civil aviation. It has given rise to two factors which are of significance to German transport politics.

Firstly, the Germans are assigned the duty of keeping serviceable and making available the ground organisation, thus airports and airway traffic control, for the new airline services within the German frontiers.

Secondly, the Germans are given the task of concerning themselves with the effects and repercussions of these new air services on the national transport economy of Germany, with the aim to organise a co-operation between all modes of transportation, including civil aviation.

If the Germans wish to take this duty and this task seriously, then it is necessary that they first acquire a clear picture of the progress civil aviation has made during the last ten years, this in order that they may bridge the gap between now and the time when Germany and Germans were once active participants in the technical and commercial development of civil aviation. Such a recapitulation is made all the more necessary by the fact that a structural transformation of civil aviation in the last decade has enabled certain technical and commercial goals to be attained ; and it is now that the position of air transport can be distinctly walled off from that of transportation in general.

In order to achieve this, a detailed study should be made of the participant zones and the working organisation of world air transport ; furthermore of the operational and transport value of present-day world civil aviation, from the safety, capacity and economy standpoints ; and finally of the traffic distribution and the possibilities of co-operation between civil aviation and the inland and overseas transport media competing with it. Throughout, the reserve must be made that the present disturbed position in many European countries still partly impedes a clear view of the final outcome.

II. The Participant Zones

The special significance which civil aviation has always had for the power political economy of the civilised countries, has been reinforced in the last ten years by marked progress in one domain : the period of technical experimentation, aiming to knit closely the network of world air transport, has reached a certain goal in that the North Atlantic can now be flown on a commercial basis. From the technical standpoint, the airfaring countries are no longer faced with any difficulties as regards taking their places in world aviation. Whereas before the war, aviation politics were governed to a certain extent by the European countries' keen interest in establishing close connections by air between the motherland and the overseas possessions, the accelerated formation of major spheres of influence in the East and West of Europe, and their ideological opposition, has turned Europe into a highly important object of power political aims between the East and the West. Civil aviation, more than any other transport activity, must adjust itself to this new geopolitical situation.

The new situation will have a positive and a negative effect on European civil air transport, and these effects are also of significance to Germany. On the one hand, Europe, as a power political centre of gravity of the first order, will be especially well equipped with international airline links. This is a marked advantage. On the other hand, however, the European airline companies will be faced with strong competition from carriers based in other countries and supported by the political aims of their respective Governments. The magnitude of this problem is underlined by the advance which U. S. airlines now have in international civil aviation.

III. International Co-operation in World Civil Aviation

Two phenomena are characteristic of the postwar situation. First, the nations have shown themselves more willing to study jointly all civil aviation problems through a world organisation ; second, the world airline network has acquired a typical structure in a relatively short time.

At the instigation of the U.S.A., the Provisional International Civil Aviation Organisation was founded in Chicago in 1944 ; it now has its permanent seat in Montreal, and all countries except Russia have joined it. Later, in 1946, it discarded its provisional character and became ICAO. In Chicago, the U.S.A. proclaimed five freedoms for international

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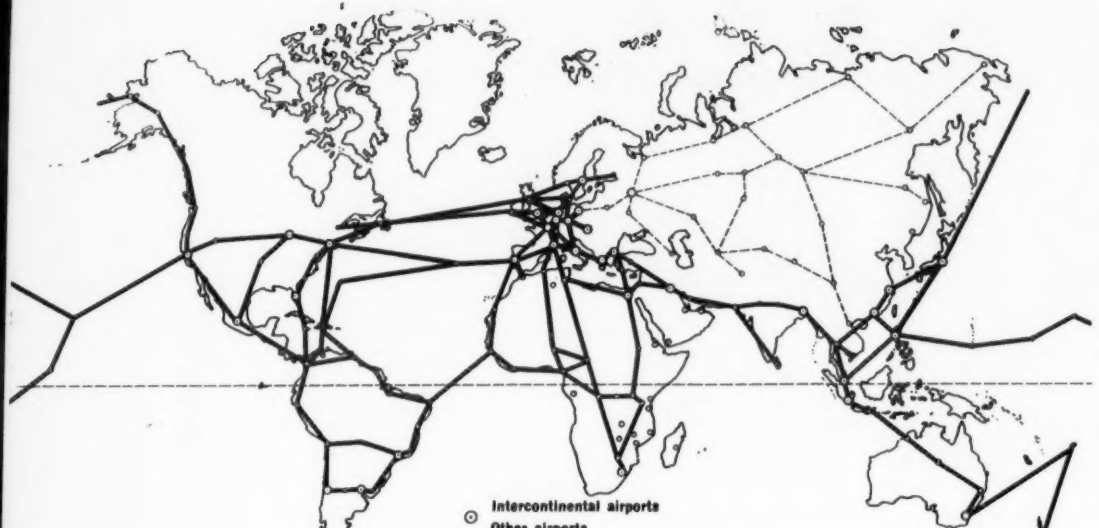


Fig. 1 : The world airline network in 1947.

civil aviation, granting the foregoing rights :

1. The right to fly over the territories of all contracting States.
2. The right to effect technical landings everywhere.
3. The right to transport passengers, mail and freight from the country of origin to the country of a contracting State.
4. The right to transport passengers, mail and freight from the territory of a contracting State to the country of origin.
5. The right to transport passengers, mail and freight between any two contracting States.

As a basis for the introduction of these rights, all forty-six contracting States unanimously agreed to strive for standardisation in airway control and navigational procedures, but the implementation of the rights, as such, gave rise to a distinct opposition. Under the leadership of Great Britain, many countries opposed a complete freedom of this sort, since the technical superiority of the U.S.A. led them to fear competition from that country. After long negotiations the principle of bilateral agreements, granting reciprocal rights, was finally accepted, whereby the governing factors were mostly the traffic capacity and flight frequency of the participant countries. Complete freedom in international civil aviation has therefore been put off until another day. The freedom in sea traffic was not achieved from one day to the other either. Nations fought for it for two centuries.

One result of this new international co-operation in civil air transport is a world airline network with an organised working structure (Fig. 1). In the global field, Europe is a typical bridge-head of power politics between the East and the West, but also a first-class short-line traffic domain. Perhaps nothing accentuates more strongly the necessity of European co-operation than the tremendous airline knot tied over Europe, which concerns the common destiny of all European countries. The classical centre of European culture, the Mediterranean, can be crossed by ship in twelve hours at its narrowest point of 400 kilometres, whilst the Atlantic, 4,000 kilometres at its narrowest point, can be crossed by air likewise in twelve hours. In the light of world aviation, the Atlantic has become the core of western civilisation, at the borders of which four parts of the world represent the supporting pillars. In this picture, Germany occupies a border position, which becomes all the more pronounced when one makes a comparison between European civil aviation in the years 1937 and 1947. In 1937, Germany developed into the crossroads of European air transport ; by 1947 she had become the main terminal, surrounded by the well-developed networks of northern, western and southern neighbouring States. Today it is most of all the Scandinavian countries who have taken over Germany's erstwhile position in European civil aviation.

From the organisational standpoint, the intercontinental airline network of 1947, comprising about 210,000 route kilometres, was flown by twenty airline companies : nine European, five North American and six from other parts of the world. The approximately 610,000 route kilometres of the world's domestic and continental networks is operated by thirty-eight carriers of continental significance and eighty of regional importance. (Table 1.)

Over the intercontinental lines, the companies operate according to two principles :

1. According to the principle of international shipping, which begins or ends at the edge of a continent.
2. According to the principle of the indivisibility of the air space, by which the companies base their operations on a continental network and are able to fly not only the intercontinental lines, but also their specific continental and national networks.

The first principle, though less strongly represented, has all the same been adopted by the two most important airfaring countries, the U.S.A. and Great Britain. All the other countries have accepted the second principle as basis for developing their national airline companies. Each of them has entrusted both continental and intercontinental operations to one company or group of companies.

From the standpoint of political economy, the second principle can turn out to be the more profitable one if good revenues from the international services can be made to offset the frequent losses suffered in domestic operations. However, which is the best

Table 1 : Length and density of continental and intercontinental airline networks in 1937 and 1947

Continent	Intercontinental network 1,000 kms.		Continental network 1,000 kms.		Both together 1,000 kms.		Network density in continent. air transp. per 100 sq. kms.	
	1937	1947	1937	1947	1937	1947	1937 kms.	1947 kms.
Europe	16.9	34.8	87.4	89.0	104.3	122.3	0.787	0.818
North America	16.8	52.9	88.5	224.6	105.3	277.5	0.368	0.934
distributed between :								
U.S.A.	16.8	—	68.4	143.6	85.2	143.6	0.872	1.832
Canada and Alaska	—	—	12.0	47.8	12.0	47.8	0.103	0.411
Central America	—	—	8.1	33.2	8.1	33.2	0.177	0.726
South America	20.3	27.8	19.8	62.0	40.1	89.8	0.104	0.33
Africa	26.8	38.0	29.2	99.7	56.0	137.7	0.097	0.332
Asia	37.0	40.1	52.7	80.3	89.7	120.4	—	—
Australia	7.8	13.6	18.7	56.6	26.5	70.2	0.220	0.734
Total	125.6	207.2	296.3	612.2	421.9	817.9	—	—

principle is still being disputed, as the present sharp differences of opinion in the U.S.A. show. In that country, in order to clarify the position, a choice has been made in favour of a combination of the two principles, resulting in "controlled competition." Of the four big U.S. carriers, three have their roots in a continental network, whilst the fourth flies only intercontinental routes. Charateristic of the present freedom from technical barriers hindering operations over land and over water, is the fact that Switzerland now operates a number of international routes.

The principle of bilateral air agreements is clearly expressed in the interwoven pattern of intercontinental air routes. Fig. 2 shows the separate route distributions among the carriers of Europe, the U.S.A., and other parts of the world. Whilst this clearly shows the leading position occupied by American aviation, it reveals with equal clarity the central significance of Europe in world aviation. A zonal distribution of traffic does indeed exist, insofar as Africa is served primarily by European carriers and the border regions of the Pacific above all by U.S. airline companies. The U.S. carriers' networks embrace the Central European space in the north, west and south, and lend special emphasis to the bridge-head nature of Europe.

Compared with 1947, it can now be seen that there is an increasing tendency for the same routes to be flown by more than one company, thus giving rise to ever fiercer competition. Up to five carriers can be found flying the same continental route in Europe or the U.S.A. As Fig. 2 shows, competition in intercontinental civil aviation is highest over the North Atlantic, where nine carriers fly the same route. A good example as regards European continental operations is the Copenhagen-Stockholm service, where eleven different carriers fly the same itinerary, some of these being from outside Europe.

The U.S. domestic airline network is the densest of all. It amounts to 1.7 kilometres per 100 square kilometres, as compared with 5.2 kms./100 sq. kms. for the railways. In Europe, this ratio is 0.8 to 7.2.

From the business standpoint, the majority of U.S. carriers are run on a private enterprise basis. In the other countries, above all in Europe, we find joint State-private untertakings, with the scales tilted more or less on the side of the State.

Organisationally, it is very interesting to see that the U.S.A. is earmarking large sums ($500 million for airport construction) for developing regional services operated by small, non-scheduled carriers, whereby the aim is to define the limits of competition between air transport and the other national means of transportation. In 1946, 2,320 carriers operating 5,500 aircraft were active in this field, so that an average of 50 carriers per U.S. State may be computed, taking about 160,000 sq. kms.

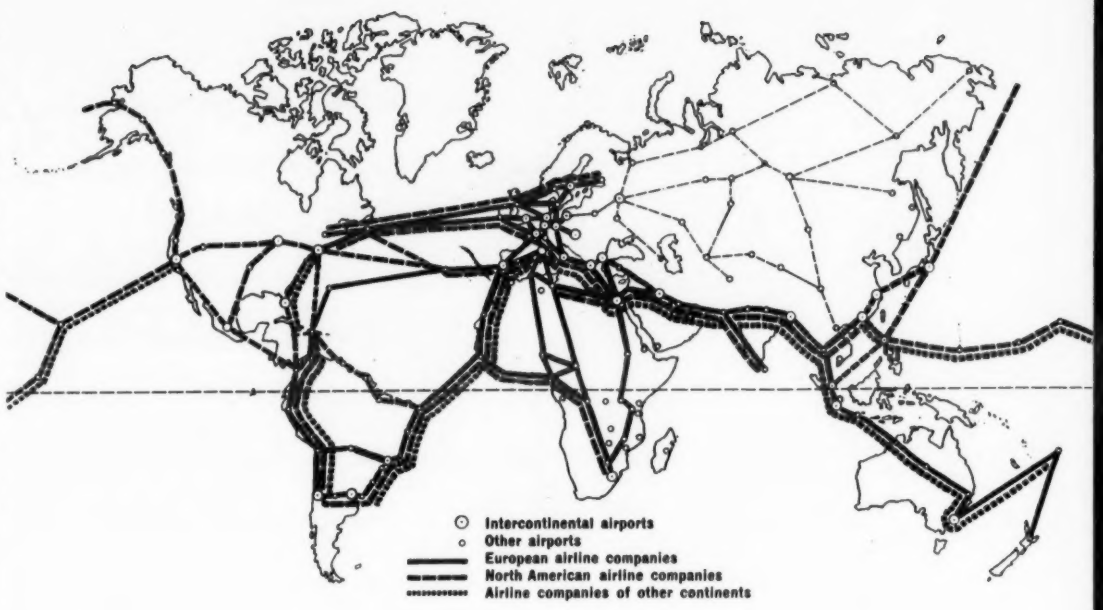


Fig. 2: Interlacement of world airline networks in 1947.

as the average area of a State. This development could be compared with the former Federal Aid Highways Grant, in 1921, by which, at an expense of $1,500 million, the huge U.S. highway network was created, which gave such impetus to motor car traffic.

Judging by results so far, these local passenger services have not met with great success. On the other hand, however, air parcel post seems to have progressed favourably, now that it has been possible to reduce freight tariffs considerably without incurring economic losses for the airline companies. Thus we find the Americans carrying out studies to obtain the smallest air traffic zones, which bear a marked similarity to experiments formerly tried in Europe and frequently an object of derision in the U.S.A. Whilst the postwar excess availability of pilots and flying equipment has favoured the growth of such regional air services, it has also complicated the assessment of the real commercial value of these services. Similar attempts are being carried out in France.

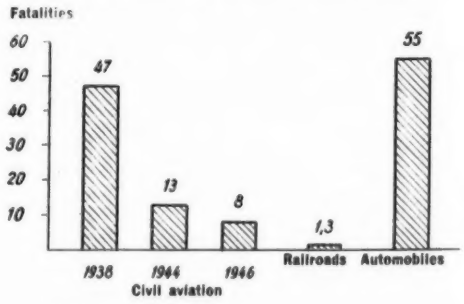
IV. Operational and Commercial Value of Civil Aviation

In order to form a judgment of the progress made by civil aviation in the last ten years, it is important to assess its traffic and commercial value, in terms of safety, capacity and economy. Without going into the details of its development, the following general facts should be pointed out in this connection.

The *safety* in U.S. civil aviation, according to Fig. 3, has improved sixfold as compared with 1937, and has consequently closely approached the safety offered by the railroads. This is primarily to be attributed to the improvement of technical installations on the ground and in the air, as well as to the careful training of crews and traffic control personnel.

The *capacity* has been increased considerably, thanks to the introduction of aircraft which fulfil present-day needs as regards payload, range, comfort and, above all, speed. It has been found that 40-seater aircraft are best suited for continental operations, and 50-to-60-seaters for intercontinental use, both types being able to cruise at 250 m.p.h. The average gross weight is between 20 and 50-55 tonnes. The load factor in U.S. civil aviation amounts to 54-75 per cent. of the load capacity (? —Ed.)

1. Total of fatalities per 1,000 million passenger-kms.



2. Cause of accidents

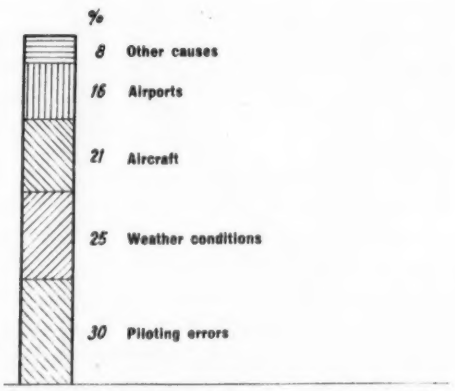


Fig. 3: Development of airline safety from 1936 to 1946, compared with surface transport media in the U.S.A.

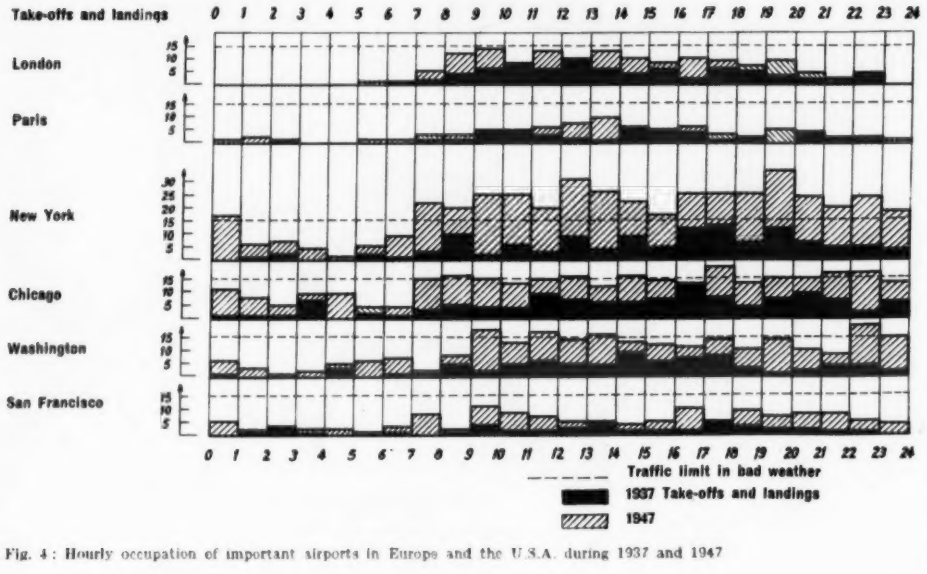

Take-offs and landings
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
London
Paris
New York
Chicago
Washington
San Francisco
Traffic limit in bad weather
1937 Take-offs and landings
1947

Fig. 4: Hourly occupation of important airports in Europe and the U.S.A. during 1937 and 1947

Table 2: Frequency of services in one direction in intercontinental air transport and trans-oceanic shipping during 1937 and 1947

Traffic link	Number of services per week offered by airline companies based in: 1947						Total 1937	by trans-oceanic shipping companies	
	Europe	North America	South America	Australia	East Asia	Total 1947		1937	1947
1. Europe—North America—North Atlantic	34	73	—	—	—	107	—	20	
2. Europe—South America—South Atlantic	12	4	9	—	—	25	2	6	
3. North America—South America	—	37	5	—	—	42	6	6	30-50 % of 1937
4. Europe—Africa [1]	33	5	—	—	—	38	4	5	
5. Europe—Middle East	12	7	—	—	—	19	6	3	
6. Europe—East Asia	16	5	—	1	—	22	6	3	
7. Europe—Australia	3	—	—	3	—	6	2	2	
8. North America—East Asia	—	10	—	—	1	11	1	4	
9. North America—Australia	—	3	—	1	—	4	—	1	
Total	110	144	14	5	1	274	27	50	

[1]) The 38 services between Europe and Africa break down as follows: Europe-North Africa . . . . . 10; Europe-Central Africa . . . . . 16; Europe-South Africa 12; 38

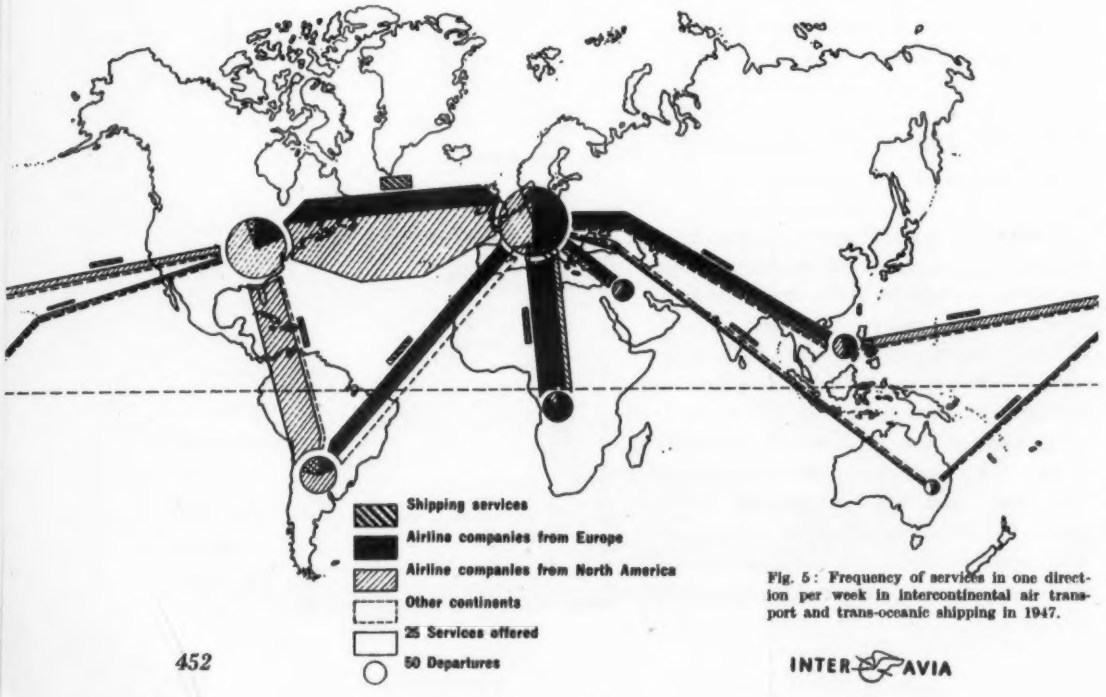


Fig. 5: Frequency of services in one direction per week in intercontinental air transport and trans-oceanic shipping in 1947.

An important problem concerns the ability of airports to cope with operations during bad weather, in cases where at the most fifteen aircraft can take off and land each hour. As regards European airports, according to Fig. 4, this number is not quite reached, but two to three times this number is sometimes attained on U.S. airports. This creates an impasse which must be overcome if the reliability of air transport is not to suffer a setback. Since a reasonably large airport usually covers an area of 1,000-1,200 hectares, thus about the area of the entire Hamburg dock area or seven to eight times that of a large railway station, increasingly more importance is being attached to the planning of intercontinental and regional airports, the latter requiring considerably less area. In this connection arises the difficult problem of selecting a suitable location for a country's central or intercontinental airport. The favourable geographical location of such an intercontinental airport, in relation to aviation's biggest needs and to the remaining traffic networks, is just as important as the suitable topographical selection of a site which fulfils all requirements of airway traffic control.

Whereas the limits of the technical aspects can be clearly defined, the traffic density of routes and airports directly concerns the traffic requirements of and the traffic distribution between the various airline companies. Whereas on European continental air routes, the occasions for daily traffic in one direction amount to fifty per cent. of the corresponding railroad traffic, in the U.S.A. they are two to three times more than those of the railways. The most marked example is the New York—Washington route (365 kms.), with 54 daily airline connections against twenty railroad services.

On the North Atlantic, the twenty crossings in 1937 by ship are today confronted by 107 airline links in one direction. (Fig. 5 and table 2 present this comparison graphically.)

These graphic presentations furthermore give a valuable impression of the distribution of flights over the three intercontinental aviation zones — Europe, North America and the other parts of the world: the U.S.A. controls the North Atlantic and the Pacific, Europe's main operations are in the southern and eastern areas of the world. A study of any one of our present world routes reveals that the frequency in air transport has considerably exceeded that in prewar shipping. This development was doubtlessly greatly favoured by the fact that shipping, as a result of war losses, has only 30 to 50 per cent. of is prewar capacity. Moreover, the present necessity

to order airline tickets four to five months ahead, is further evidence of the psychological advance which civil aviation has gained over trans-oceanic shipping.

The geographical intensification of civil aviation, recognisable from the number of airports and their average distance from each other, is shown for the last decade in Table 3.

In almost every part of the world, the number of airports used on a scheduled basis has increased in a greater measure than the average distance of the airports from each other. Germany's disappearance from European civil aviation is evidenced by the present smaller number of European airports than in 1937. Whilst considerable differences in the distances between airports were to be seen in 1937, a strong analogy, within the range of 400 to 600 kms., is visible for 1947, which may above all be attributed to an intensification of civil aviation in the new continents.

The *economic* aspects are of special interest. In studying the commercial value of air transport, or the problem of balancing the expenses with the revenues, it must be borne in mind that about 20 to 25 per cent. of the entire costs are shouldered by the airports and airway traffic control organisations, whilst 75 to 80 per cent. are the burden of the airline companies. Thus, as regards the airlines' responsibility of fully covering their costs with revenues, we find a situation similar to that pertaining to highway and artificial waterway traffic in all countries, whereas the railways are compelled to balance their entire expenses with revenues.

It is with this in mind that all economic features of civil aviation must be judged. If the airline companies are able to function independently, on the basis of their pure traffic revenues, then civil aviation can be regarded as healthy. In this way, Fig. 6, for example, shows the development of traffic during the 1935-1946 period for U.S. domestic operations. It is particularly interesting to see that a major portion of passenger traffic has always been in evidence, whereas mail and freight have played a considerably smaller rôle. Since 1937, the U.S. carriers have been operating with increasing profits, amounting to about 5.5 per cent. of operating revenues during 1945. 1946 was marked by a 2 per cent. loss, resulting from the unfavourable influence of a number of serious crashes. KLM Royal Dutch Airlines, which possesses very modern flying equipment, has also been working at a profit since 1946. A similarly favourable ratio is only seldom evidenced by other European airlines. Some of them reveal 15 to 30 per cent. losses, mostly caused by obsolete flying equipment, whereby American airliners are not included, or only form a small part of the entire fleet (Great Britain). In the case of the European state-controlled airlines, capital is frequently invested at no interest.

Table 3 : Number of and average distance between airports used in scheduled air transport during 1937 and 1947

Continent	Airports				Route kilometrage 1,000 kms.		Average distance between airports	
	Altogether		Intercontinental airports					
	1937	1947	1937	1947	1937	1947	1937	1947
1. Europe	229	200	9	13	87.4	89.0	380	445
2. America :								
U.S.A.	178	253	3	3	68.4	143.6		560
Canada, Alaska	—	103	—	—	12.0	47.8	450	465
Central America	42	75	1	2	8.1	32.2	200	440
3. South America	112	108	3	3	19.8	62.0	180	575
4. Africa	128	245	2	2	29.2	99.7	230	400
5. Australia	51	197	1	1	18.7	56.6	370	300
6. Asia	180	134	8	8	52.7	80.3	290	600

In connection with this result, it is important to ascertain the ratio in which the three sources of revenue — passengers, mail and freight — contribute towards the total revenues. Here it is convenient to use the tonne-kilometre as scale of comparison, using as yardstick the fact that one passenger-tonne-kilometre is equal to ten passenger-kilometres, with passengers representing 100 kilograms (70 kgs. + 30 kgs. luggage). The passenger-tonne-kilometre brings in the highest revenue, the freight-tonne-kilometre the lowest, and the mail-tonne-kilometre lies between the two. The differences between continental and intercontinental traffic result from the greater speed provided by aircraft than ships, which has made it possible to impose higher tariffs for air travel. Though airline tariffs have been steadily decreased in the last decade, there are many signs to show that a certain firm level has now been reached.

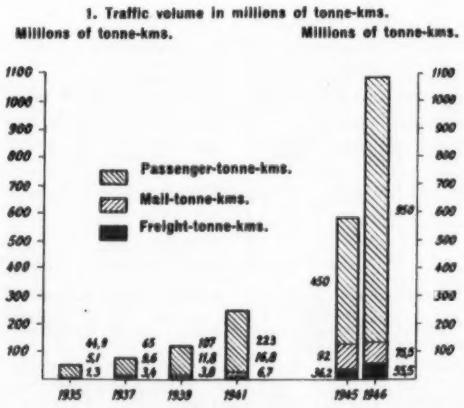


Fig. 6 : Traffic volumes in U.S. domestic air transport during 1935-1946.

A general review of the economic aspects clearly reveals the fundamental principle that civil aviation is still only suitable as a means of transportation for commodities enabling high tariffs per weight unit to be imposed, and which only amount to between 1 and 1.5 per cent. of the entire traffic volume.

V. Co-operation and Traffic Distribution between Civil Aviation and Other Means of Transportation

The considerable increase in safety, the great frequency of services, and the time-saving offered by greater speeds, have considerably sharpened competition between civil aviation, continental surface transportation, and overseas shipping. It finds its limits in the relatively high tariffs which the airlines have to impose. The greater the time-saving, and the smaller the differences between tariffs imposed by the airlines and by other means of transportation, the greater the degree to which the other means of transportation will be affected by the development of civil aviation. Whereas in continental traffic up to 1947, the advance of civil aviation over the railways changed only very little as compared with the situation in 1937, the advance in world transport (aviation and shipping) increased two- to three-fold. Today, the time-saving offered by aviation on overseas routes is seven- to thirteen-fold.

In accordance with the saving in travel time, the airline tariffs have been made far higher than those of the railroad and shipping companies. The very large gap between freight tariffs imposed by shipping companies and airlines will cut down the volume of this commodity for aviation, just as, conversely, the small difference in passenger tariffs will result in large passenger volumes for aviation.

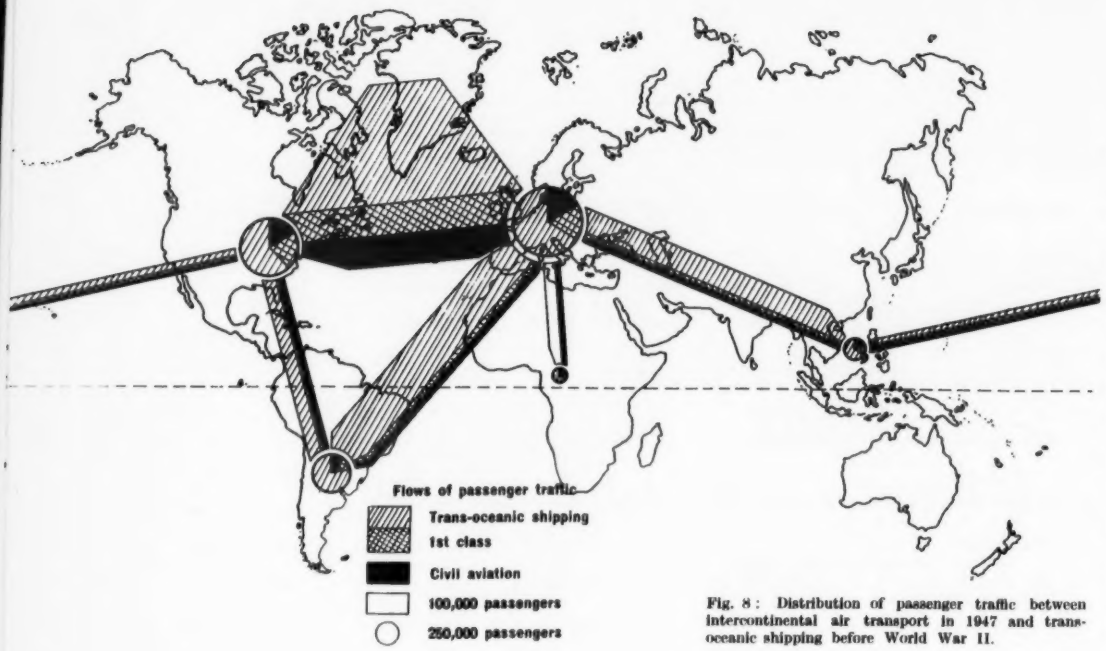
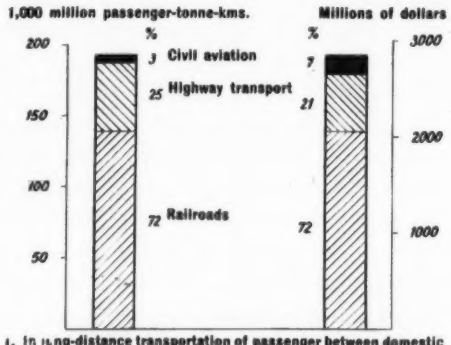


Fig. 8 : Distribution of passenger traffic between intercontinental air transport in 1947 and trans-oceanic shipping before World War II.

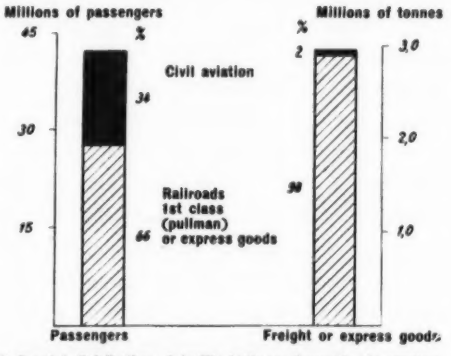
On the basis of the ratios between tariffs and between speeds, a typical traffic distribution between the aircraft and other transport media is discernible in continental and intercontinental traffic ; this is shown in Fig. 7 for U.S. domestic traffic and in Fig. 8 for world transport. As regards long-distance transportation of passengers in the U.S.A., the passenger-kilometres today divide up as follows : 3 per cent. to the airlines, 25 per cent. to the highway transport concerns, and the remaining 72 per cent. to the railways. As regards revenues, the ratio is more favourable for aviation, being 7 per cent. against 21 and 72 per cent.

The special traffic distribution between railroads and airlines revealed in 1946 a transfer to the airlines of 34 per cent. of the passengers otherwise travelling first class by the railroads. In express goods carriage, on the other hand, the portion carried by the airlines was only 2 per cent., a very low figure which is in part

Fig. 7 : Traffic distribution between U.S. domestic carriers and continental surface transport media in 1945 and 1946.



1. In long-distance transportation of passenger between domestic air carriers and surface transport media in the U.S.A. during 1945



2. Special distribution of traffic between domestic air carriers and railroads in the U.S.A. in 1946

Table 4 : Intercontinental air transport and trans-oceanic shipping during 1936 and 1947

Traffic link	Annual volume of passenger traffic in both directions						
	Shipping 1936		Intercontinental air transport				
	Passengers		Passengers				% of column 3
	1st Class	Total	1936	% of column 2	1947	% of column 2	
1. Europe—North America	187,000	980,000	1,002 [1]	0.5	220,000	118	22.5
2. Europe—South America	41,000	290,000	1,083	2.1	31,000	75	10.7
3. Europe—South-east Asia	19,500	130,000	1,875	9.8	23,000	120	17.5
4. Europe—Africa	14,000	98,000	1,563	11.0	19,500	140	20.0
5. North America—Asia	8,500	53,000	150	2.0	7,800	91	15.0
6. North America—South America	11,200	94,000	1,440	13.0	21,600	197	34.0
Total	281,200	1,645,000	7,113	2.5	322,900	115	20.0

[1] Zeppelin operations with a total of 20 flights in both directions.

explained by the fact that air cargo transportation is still in its infancy. No corresponding figures are available for Europe, but it is doubtless that the traffic distribution is much on the same lines as in the U.S.A. At the present moment, the damaged railroad installations in many European countries are having a favourable effect on air transport. But, on the other hand, it must not be forgotten that international civil aviation, too, is still heavily burdened by innumerable formalities (currency and police), which have to be respected daily by carriers and travellers before each flight. In time they become unbearable. Thus, if civil aviation has been able to progress as it has done, despite these official barriers, it is ample proof of its positive commercial value.

Most informative of all is the traffic distribution between the airlines and the shipping companies in world transport, as presented in Fig. 8 and table 4. Here are shown, separately, the traffic flows (total, in both directions) for shipping, with the proportion of passengers travelling first class ; furthermore, the corresponding air traffic flows for 1947. Choice had to be given to 1937 as a normal year of peace for shipping, since it is not possible to obtain a clear picture of present shipping activities. The circles reveal the proportion of airline passengers to ships' passengers for the different parts of the world. For the North Atlantic, the number of airline passengers is already higher than that of passengers travelling by first class on ships, and attains 22 per cent. of the total number of prewar ships' passengers. The share of civil aviation on the North America—South America route is greater still. On the average, the airlines today carry 20 per cent. as many passengers as the shipping companies did in 1937.

There could be no more conclusive confirmation of the thesis that civil aviation's main potential lies on the great, intercontinental routes. This gives rise to transport political problems of far-reaching significance for trans-oceanic shipping throughout the world. Added to the inland competition between the national means of transportation is the competition in international transport over continental and, above all, intercontinental routes. Here, too, healthy transport politics must be based on the principle that the global transportation of every country must be treated in an increasing measure as a unit which must be jointly built up by shipping and air transport.

Aircraft Seek Customers

TODAY

The telephone rings in the office of the Technical Department of the Ophirian Air Force : Colonel X, the Illyrian Military Attaché (economy measures in Illyria do not allow for the appointment of an Air Attaché), would like to speak with Colonel Y, Head of the Technical Department of the Ophirian Air Force.

"How do you do, sir ?"

"Very well, thanks, and you ?"

"It is my privilege to inform you that the Managing Director of Backward Aircraft Co., Mr. R.U. Stoneybroke—I don't know whether you've already made his acquaintance—will pay you a visit. He intends travelling to Ophir in the near future, and would be pleased to demonstrate to you his new long-range supersonic fighter-scout-bomber. As you probably know, this aircraft is at present on my country's secret list, and that we are seriously considering putting it into large-scale production. However, in view of the amiable relations between our two countries, and my friendly attitude towards you personally, we would eventually allow you to purchase a small series of this extremely valuable aircraft."

All this is very much to the taste of the Head of the Ophirian Air Force Technical Department . . . Fully aware of his high position of authority, he answers with typical military efficiency :

"Very interesting indeed ! We shall be very keen to see this aircraft. Personally, I am extremely grateful to you. I look forward with the greatest of pleasure to receiving Mr. Stoneybroke, whom I've always held in the highest esteem (as a matter of fact, he had never heard of him before). Unfortunately, I shall be very much under pressure next week as my Minister envisages sending me abroad. But I shall immediately inform my superior. The Commander-in-Chief will likewise be extremely gratified about this good news. Could I perhaps communicate with you tomorrow ?"

"I assure you that nothing would please me more, Colonel Y."

And what happens now ?

The technical officer runs along to his Commander-in-Chief in order to deliver the message hot off the wire. It goes without saying that neither has the Commander-in-Chief the faintest idea who Mr. Stoneybroke is. His knowledge of the activities of the Backward Aircraft Co. are equally as vague, and the description of the aircraft conveys almost nothing to his mind. All that he knows about aviation is that it involves aeroplanes.

But he all the same keeps a straight face, simulates an increasing interest in the news, and pompously reserves his decision. No sooner is he alone again than he has his adjutant and personal secretary come into his office and, while adroitly concealing his ignorance, obtains from them the most elementary of explanations.

The adjutant, of course, grasps the situation at once. To his mind come the following main questions : How do we stand with regard to Illyria ? What are our diplomatic and commercial relations with this country ? What do we know and what can we find out about Backward Aircraft Co. ? Who exactly is Mr. R.U. Stoneybroke ? What has their newest crate got to offer ? Do we need it, and have we enough money to pay for it ?

Four weeks go by, and one can optimistically assume that the above problems have been solved by the Ophirian Ministries of Foreign Affairs, Trade and War. After a whole number of departments have come to some form of agreement, Colonel Y, Head of the Air Force Technical Department, receives his orders. By all means have Mr. Stoneybroke come to Ophir with his wonder plane. But, for heaven's sake no promises, no formal signatures . . . just a light luncheon party.

The telephone starts buzzing again between the Ophirian Technical Department and the Illyrian Legation. Once again, the usual politenesses are exchanged. There are no diplomatic obstacles in Mr. Stoneybroke's way ; the demonstration can take place.

After another four weeks, matters get that far. Everything proceeds "with utmost secrecy" before wide sections of the general public.

The best hotel of Ophir's capital rolls out the red carpet for the guests : Mr. R.U. Stoneybroke, Managing Director of Backward Aircraft Co., accompanied by six engineers with slide rules protuding from all pockets, three lean-featured test pilots, and a shifty-looking, bespectacled person representing the company's commercial department. The mutual exchanges of courtesy are too exquisite for words. The Ophirian officials are amazed to find that their Illyrian guests can speak Ophirian like natives.

The first step is to take them around the Air Force Technical Department : catalogues, pictures, computations, drawings . . . lots of paper. Questions are asked and answered with the utmost discretion. There's a lot of talk about the weather, a few cautious remarks about the international situation, but not a word about aircraft.

In the evening the representatives of Backward Aircraft Co. stage a reception, attended by the staff of the Illyrian Legation. The Minister proposes a toast to the President of Ophir, to the incomparable Ophirian Air Force, to Ophir's invaluable contributions to the world of music, and in a roundabout way makes out that it is only in view of all these things that his own country can contemplate the heavy sacrifice of showing to Ophir the best available aircraft of the day.

The Commander-in-Chief of the Ophirian Air Force, for his part, stutters out a speech in Illyrian, which he reads from a page compiled jointly by his adjutant, the Foreign Minister, and the Chairman of the National Bank . . . "Very flattered . . . highly pleased . . . greatly interested . . . long live the Emperor of Illyria !"

The food and the wine are good. It is almost daybreak by the time they part company, and everybody is in high spirits . . .

Next morning, limousines are waiting to take the V.I.P.'s to the airport, where the carefully polished and closely guarded aircraft stands gleaming in the sun.

Take-off ! On board are all three pilots, but also a film star who, having suddenly appeared on the scene, arouses the strategic interest of the guests and secures herself a seat by her winning smile. Backward Aircraft Co. is of course represented by Mr. Stoneybroke, and Ophir by a selected delegation, headed by the C.-in-C. He had faithfully promised his wife that morning that he would be careful and only view the aircraft from the ground. But, after all, a man can't let his country down in its hour of need, so he plays the hero and prays silently.

Left roll, right roll, steep ascent, crash dive . . . The General suffers tortures.

Landing ! Released from the deadly missile, the Ophirian delegation is none too profuse with its compliments.

Everybody goes back to town and sits down to the scheduled light luncheon. After the coffee and liqueurs, Mr. Stoneybroke makes a valiant effort to get down to business. For him, success is by no means just around the corner.

As a matter of fact, he is pretty fed up. He knows perfectly well that the Ophirians react slowly, that the Chairman of the National Bank keeps a tight grip on the hard currency. In reality, he finds the C.-in-C. absolutely useless. The Chairman of the National Bank would be far more interesting. It so happens that each of these aircraft he is trying to sell, costs 250,000 gold whatsums. And it is a generally known fact that Ophir's military credits are stretched to the limit and that the left-wing radicals, since the last war, have much to say in matters about which they know absolutely nothing. They talk a lot about eternal peace, disarmament, and similar things ; they only want to spend money on cultural objects, and are planning a dozen reform institutes for released convicts . . . Confounded idiots !

To put it in a nutshell : the chances for buyer and seller are just about equal.

On the other hand, meanwhile, there are some bright points to Mr. Stoneybroke's first visit to Ophir. The shops are just brim-full of items which his wife and danghter in Illyria yearn for : nylon stockings, dairy products, watches, and so on. After fully exploiting every cubic inch of cargo space on board their aircraft, Backward Aircraft Co.'s delegation flies home.

And thus the business can be regarded—at least theoretically—as started off. All the same, however, it now begins to smack strongly of politics.

An ambassador from Saponia, a country whose aircraft manufacturing industry also has something good to offer, respectfully asks to see the President of Ophir. Both these gentlemen have known each other for a long time, and their meeting is characterised by the approved measure of mutual distrust. Conversation opens with a few remarks about the last commercial pact which, since it is already settled in every detail, is hardly worth talking about. Then the Saponian ambassador plucks up his courage :

"Your Excellency, my Air Attaché believes to have heard that certain officers of your Air Force are interested in an aircraft produced by Backward Aircraft Co., of Illyria. It goes without saying that this matter does not concern us. However, the cordial relations between our two countries compel me to draw your attention, in all confidence, to the fact that Backward Aircraft Co. should be approached with the utmost caution. Reports have come to our ears of broken wings, engine failures, crashes, a death-toll of 73 . . . I would point out that under no circumstances are we desirous of having our name mentioned in connection with this matter. But your Excellency need not be reminded of our firm economic relations. You will surely recall the last trade exchange between our countries, when we accepted from you fifteen truckloads of darning needles in return for a quantity, equally indispensable to us, of hog bristles . . . In the name of my Government, I undertake this painful duty, and respectfully advise you to proceed with the utmost caution in your negotiations with this Illyrian firm of aircraft manufacturers."

The unhappy President ! He hasn't the faintest idea of what all this is about.

Once more the telephone rings, and the President asks to speak to the C.-in-C. of the Air Force : "What's all this about buying Illyrian aircraft ? Are you out of your senses, man ? I just got a confidential tip from the Saponian ambassador. You'd better forget all about Illyrian aircraft. We don't want a war, we don't want trouble, we don't want aircraft. What we need are reform institutes ! I don't want to hear another word about the matter."

* * *

But time and tide wait for no man, not even for the President of Ophir.

During the next six months, Mr. Stoneybroke and his satellites fly between Illyria and Ophir, Ophir and Illyria.

And one day the newspapers of both countries carry prominent headlines : Ophirian Government orders 350 units of famed Illyrian long-range supersonic fighter-scout-bomber, built by Backward Aircraft Co. World's most modern aircraft will make Ophirian Air Force invincible. Deliveries, to begin immediately, will be completed in not less than 30 years. Military appropriations have long been earmarked for this purpose.

And where are the reform institutes ? In the air . . . That is how aircraft are sold today.

YESTERDAY

The small country of Mimikron has always maintained a good export trade with flower bulbs. The national treasury used to be full to overflowing. The inhabitants are steady, hard-working, and used to thinking internationally. In days long gone by, they used to live off anything the sea could offer them, but, as time went on, they gradually acquired a large air fleet.

In the days before the war, Mimikron also possessed a good aircraft manufacturing industry, notably the Lekker Works. The founder of this firm was a typical Mimikronian : farseeing, energetic, and sometimes rather lavish in his habits. Numerically, his staff was not very great. But they were hand-picked. And his right-hand man was the Sales Manager, a descendant of the Huguenots, who bore the old French name of Chat-de-Mer.

In those days it was not necessary for aviation industrials to spend hours in the anti-chambers of foreign air force staffs. Of their own free will, foreigners used to come frequently and willingly to Mimikron. There was always plenty to see at the Lekker Works. Moreover, there were the numerous bars, the superb food, the charming inhabitants, and the occasional but delightful beach parties—all within a few miles of the capital city of Baalendam.

And any time such a delegation arrived, even if from only a small Balkan country—from around the Montenegrin mountains, for instance—the Mimikronians spared no effort to make their stay agreeable. Something was always done to improve their military education.

Telegram from Smerlovitz, capital of the Kingdom of Danubia :

"Colonel Rristovicz accompanied by Captain Stentostovicz and Lieutenant Klystirrovac arriving tomorrow in Baalendam to look at Lekker Works Stop Contemplate purchasing Lekker FF-606 Stop From Staff of Royal Danubian Air Force."

Baalendam made ready to receive the delegation with open arms. Hotels and limousines were prepared ; drinks and other entertainments were carefully planned. In this respect, too, the Lekker Works enjoyed an international reputation.

A reception at Ballendam Central Station, festive transportation to the hotel, a few rounds of drinks before visiting the factory . . . everything to make the guests feel at home.

The Lekker Works consisted, in the main, of a cluster of sheds, but it was all the same cosy. After a few minutes of merry conversation, Colonel Rristovicz expressed his desire to examine the Lekker FF-606 triplane.

Mr. Chat-de-Mer, Lekker Sales Manager, was quick to answer : "But of course, sir. We shall have everything ready for you tomorrow."

On the other hand, however, he was fully aware that the Danubian colonel, who had never visited Baalendam before, must be rather disappointed about his first impression of the Lekker Works. Of course, the Colonel did not fail to notice the huge chimneystack behind the works, and it was only natural that he should suppose the real plant to be over there . . . That this was in reality an optical illusion—the chimneystack belonged to the municipal garbage incineration plant—was not Mr. Chat-de-Mer's immediate intention to explain : "Terribly sorry, we can't let you have a look at that part of the factory as the Government has issued strict secrecy regulations."

But this was a minor detail, soon brushed over as Mr. Chat-de-Mer explained the programme of the day to the Colonel : "We shall now go back to town for lunch, after which you can rest from your trip. My deputy, Mr. Smits, will then pick you up, and there will be a cocktail party. We shall meet again for dinner, and early tomorrow morning the Lekker FF-606 will be ready for you. You can fly it yourself, and if you feel satisfied, you can buy it on the spot."

In the afternoon they really got down to work . . . the real Lekker tour. This consisted of visiting about a dozen bars, until the famous Baalendamer Schnapps had washed away the Danubians' last traces of home-sickness. They acquired a hearty appetite, the dinner was unforgettable, and champagne flowed like water. The entire Lekker staff was there, all carefully selected, including the ladies. It was very late when they parted company.

Next morning, under a sky which the sun had scarcely begun to redden, the party went to the airport. Out on the runway was the Lekker FF-606, with engines running. The question now was whether the foreign delegation was in a fit state to test the aircraft. In view of the festivities of the previous evening, it was really a case of the spirit being willing, but the body being decidedly weak. But a country's future was at stake ! The Colonel took a turn at the controls, followed by the captain, and afterwards by the Lieutenant. They even pulled out stop watches to measure the aircraft's speed. Happily, the stop watches were not so very accurate.

And when the Danubians clambered, somewhat wearily, out of the cockpit, their minds were made up. The FF-606 or nothing ! The aircraft had fulfilled every promise of its designers.

The contract was ready for signature.

* * *

Aircraft seek customers. They will always have to seek them, and if they look hard enough, they will surely find one from time to time.

Every business is tough, and selling aircraft is definitely one of the toughest. In days gone by, it was at least humorous from time to time. But nowadays . . . there is not much sense of humour left in the world.

X.

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THE BASIS OF EVERY NAVIGATION TECHNIQUE is a reliable meteorological service. Without good weather prognostics, flight planning is only accurate within limits. Close cooperation between ground stations, aircraft and weather ships is imperative for long-distance operations

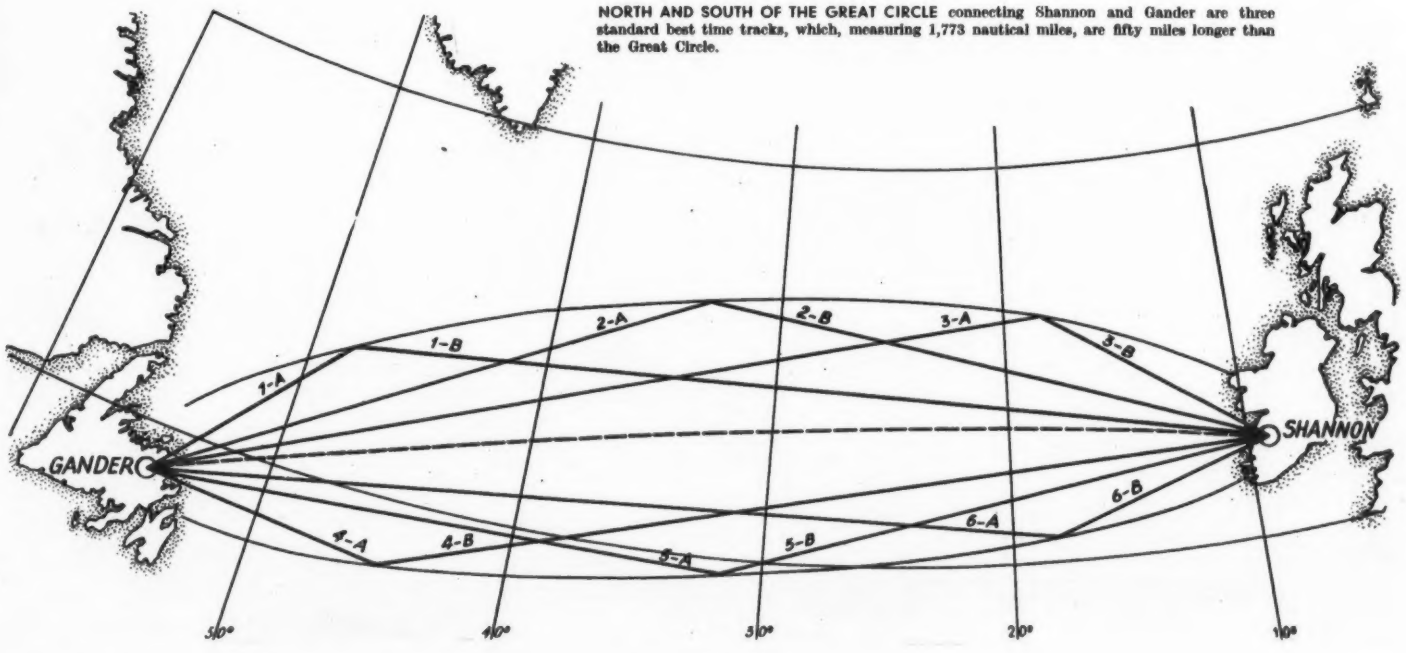
Economic Navigation

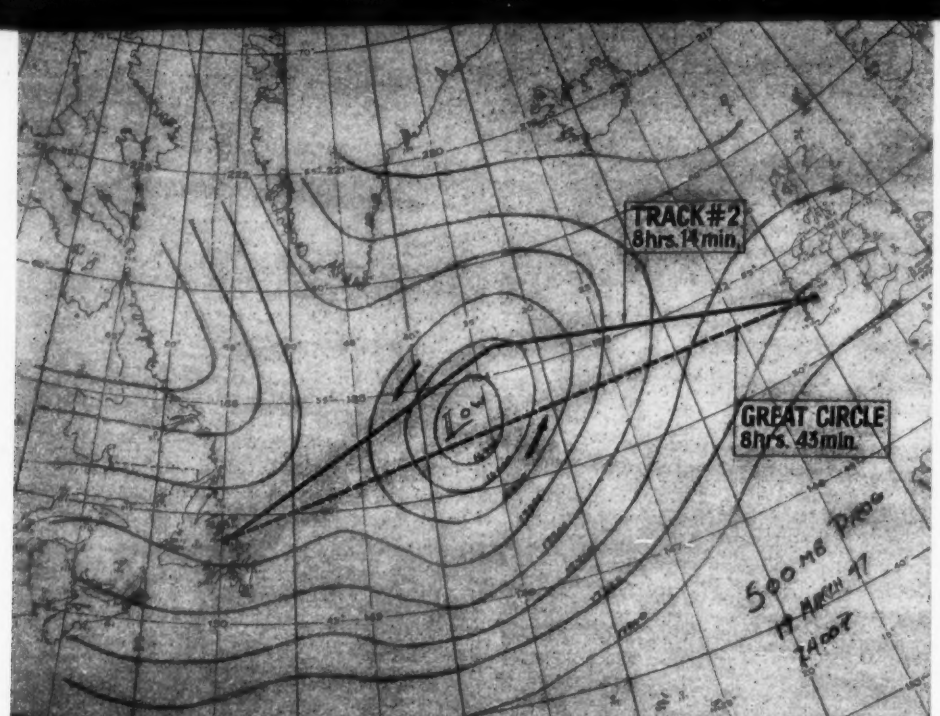
In commercial flying, navigation is no longer merely a means to one's own end, as it was only very few years ago. Thus it is no longer only the art of safely guiding an aircraft from its point of departure to a specific terminal, and being able to determine an exact position at all times. With the introduction of transcontinental and trans-Atlantic long-distance flights in scheduled air transportation, and the sharpening of competition between the various airline companies, experts conceived the fundamental purpose of profitable air transport : to carry the maximum amount of payload over a route with a given number of aircraft over a predetermined period.

Operational planning has already reached a high degree of efficiency in the art of predicting aircraft requirements in the terms of costs, revenue, and flight times. But for an international carrier, flying relatively long over-water routes with present-day equipment, accurate predetermination of flight time is of major importance.

For this reason efforts have been going on for some time to improve the primitive navigational methods, which—apart from atmospheric disturbances—enabled aircraft to be guided along the geometrically shortest path from point to point. Notably over the North Atlantic, a navigational technique known as "pressure pattern flying" was introduced. This is the art of navigating between two points, not along the shortest connecting line, but over a route which, taking into account the meteorological situation, enables the shortest flight time to be obtained. To effect time-savings, therefore, it is usually necessary to deviate from the normal Great Circle route in such a way that the ratio of miles flown to

NORTH AND SOUTH OF THE GREAT CIRCLE connecting Shannon and Gander are three standard best time tracks, which, measuring 1,773 nautical miles, are fifty miles longer than the Great Circle.





THE PRESSURE DISTRIBUTION PREDICTED BY THE METEOROLOGICAL OFFICE enables the wind components to be extracted for the separate points of the best time tracks and the probable flight times to be computed.

ground speed results in less time. Meanwhile, the amount of the deviation, with its resultant time-saving, has hitherto depended almost entirely on the skill of the navigator, which accounts for the considerable differences in individual flight times across the North Atlantic, resulting in irregularity of schedules and variations of payload from day to day.

Even if pressure pattern flying does represent an advance over earlier navigational methods, and results in the saving of time, it is evident that this can affect solely the direct operational costs of the airline companies. As desirable as it may be, to reduce fuel consumption over a specific trip length, this economy, when compared with the total expenses, is only minute.

Over the North Atlantic, which is at present flown in several sections, it is the so-called "critical" leg—Shannon-Gander for the North Atlantic—which determines the payload limit, and consequently the commercial profit on the entire run. But because pressure pattern flying can only enable time to be saved once the aircraft is on the wing, it is impossible to predict a fuel supply reduction in favour of the payload.

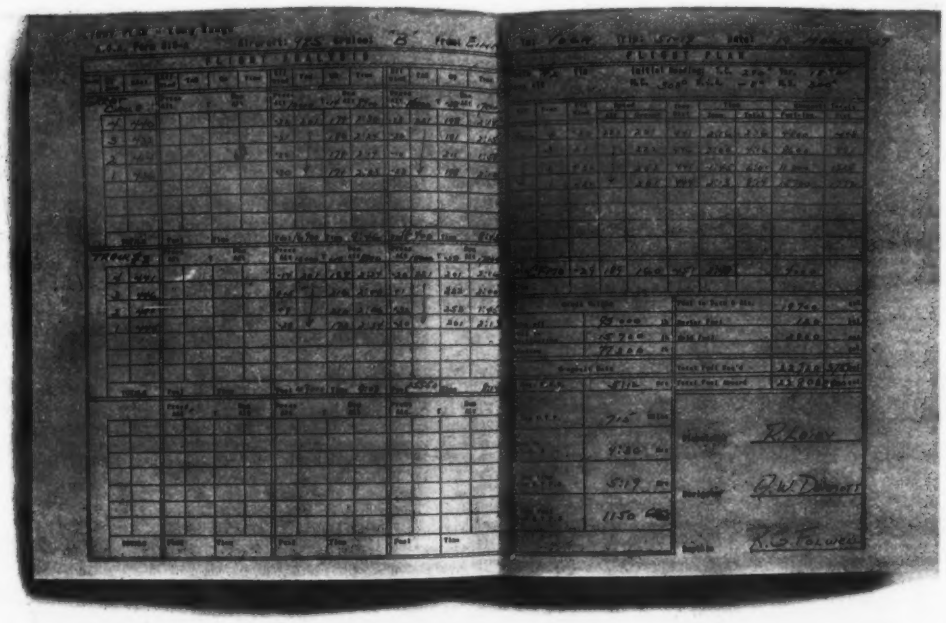
If, then, the time saving feature is to be of commercial value, and not of only academic interest, it is necessary to devise a method enabling time-saving to be planned in advance —and early enough to enable the fuel reserve to be reduced to the advantage of payload.

American Overseas Airlines have worked out such a method, which they have called "best time track" operation and which is briefly described below.

In principle, the best time track procedure represents a development and the practical application of the pressure pattern flying technique. In the case of each flight, the route is not only determined on the basis of weather data, but also by mathematical computations. An integral part of the method are eight standard tracks : the Great Circle, the rhumb line, and six composite Great Circles. These six composite "dog-leg" tracks are equal in length, each being fifty miles longer than the Great Circle. Three are located south and three north of the Great Circle. The vertices fall on the perimeter of an ellipse, and are so spaced that at least one will normally approximate a least (or "best") time track. The track pattern and limiting distance were determined empirically during a Shannon—Gander analysis of typical synoptic situations over a period of two and a half years. Since flight plans are necessary for determining the best time tracks in order to supply the requisite basis of comparison, it was necessary to create special methods of compution so that the flying speeds could be obtained in the simplest possible manner. Whilst the classical navigational methods extract winds relative to a meridian on a weather map, the best time track procedure uses only that component of the wind which directly affects the ground speed. The forecast maps, usually prepared four to five hours before flight time by the meteorology office, suffice for drawing up a flight plan in accordance with the best time track method. As a rule, this office supplies two prognostic constant pressure maps for 700 and 500 millibars, which suffice to predict the wind conditions which will be encountered by aircraft cruising between 10,000 and 20,000 feet. For aircraft flying at lower levels, other pairs of maps would be used.

More interesting than the details of the flight planning procedure are the actual experiences

FLIGHT PLAN OF A "CONSTELLATION" OF AMERICAN OVERSEAS AIRLINES, which navigates the "critical" Shannon-Gander leg between London and New York according to the best time track procedure. Choice was given to standard track No. 2, which promises a flight time reduction of over an hour.



AN A.O.A. METEOROLOGIST BRIEFS Captain James E. Douglas and Navigator Jeff Forrest on the most likely pressure pattern and the attendant enroute weather conditions. Captain Douglas will subsequently select the track offering the best time consistent with favourable flying conditions.

ENROUTE READINGS OF RADIO AND PRESSURE ALTIMETERS must constantly be compared with the weather maps.

of American Overseas Airlines during the winter, 1947, experimental and indoctrination period, prior to general introduction of the system. Right from the beginning, it was evident that the new procedure was considerably more flexible than previous techniques, being particularly suited to rapid re-routings in cases of last-minute changes in the flight plan. While time-saving is not in evidence every day, there are periods, covering several days at a time, which frequently occur and present opportunities for significant economies in this respect. A breakdown of the analysis for the experimental period showed the potential to be as follows :

West-bound flights.

1. Alternate tracks were indicated during 42 per cent. of the time.

2. Time-savings on alternate tracks ranged from six minutes to 121 minutes, and averaged 33 minutes.

East-bound flights.

1. Alternate tracks were indicated during 30 per cent. of the time.

2. Time-savings on alternate tracks ranged from four minutes to 91 minutes, and averaged 18 minutes.

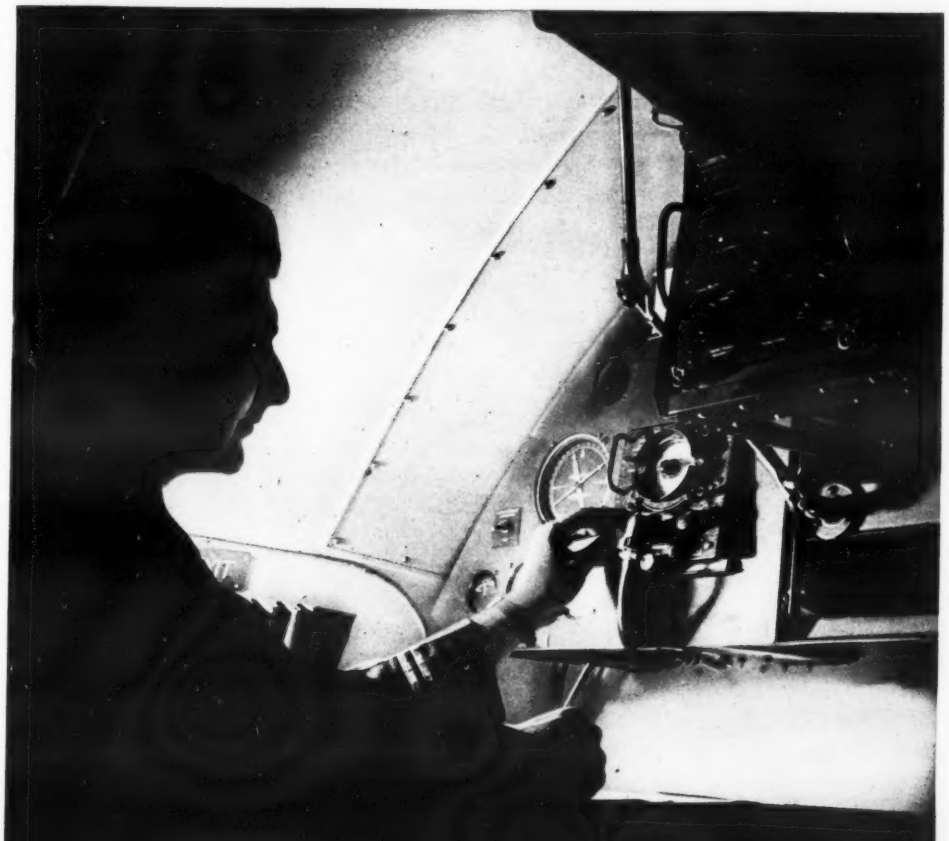
As crew indoctrination progressed, further improvement was shown :

During the entire six-month test period, 174 west-bound flights were analysed, of which 43 per cent. saved an average of 32 minutes per flight ; analysis of 153 east-bound flights showed that 37 per cent. saved an average of 23 minutes per flight. These figures encourage the assumption that, with improved upper air forecasting, ninety per cent. of the time-saving potential is within the realm of practicability.

A good example of the best time track method of flight planning is the flight plan prepared for the Shannon—Gander leg of a London—New York flight by American Overseas Airlines on March 19th, 1947, presented here pictorially. A few hours before the flight departed from London for Shannon, the Irish Meteorological Service prepared 700- and 500-millibar constant pressure maps, which predicted the pressure distribution and wind flow at approximately 10,000 and 18,000 feet respectively. A.O.A.'s despatch office in Shannon immediately analysed them for flight time. Starting with the 700-millibar pressure surface (10,000 feet) the flight time to Gander over the Great Circle was found to be 9 hours 46 minutes. Standard track No. 2 was then analysed, and was found to be 9 hours 8 minutes, thus offering a saving of 38 minutes. These results were additionally compared with the pressure distribution in greater altitude (500 millibars) ; the Great Circle route gave 8 hours 43 minutes, and track No. 2 indicated 8 hours 14 minutes. Thus, with altitude, the time saving potential increased and track No. 2 at 18,000 feet was indicated as best track for the trip. All these preparations had been completed before the aircraft had arrived from London, so that it was possible for the captain to make his decision without loss of time.

For a four-engined long-distance airliner, the fuel reserve for half an hour's flying represents a noticeable weight, which can turn out to be of significant commercial importance on "critical" legs of a long route if it can be converted into payload. It is therefore evident that an improved navigational technique, such as that developed by American Overseas Airlines, is not merely of academic interest, but of extreme practical utility.

COMPARISON OF ACTUAL AND PREDICTED PRESSURE CONDITIONS is primarily made possible by taking readings of the radio altimeter.



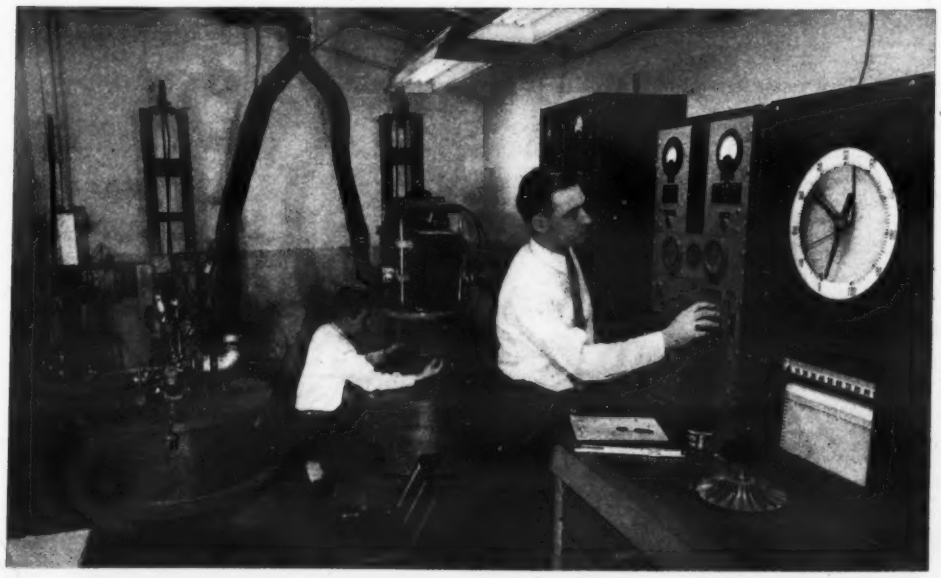
AT A SPEED OF 73,285 R. P M., this turbine wheel was photographed at the moment one of the blades flew off (top right). The flying blade automatically tripped the flash lamp and made its own picture.

Spin Tests with Turbine Wheels

With the introduction of turbo-jets as aircraft power plants, high engine speeds, far in excess of those attained hitherto with reciprocating engines, immediately became an understood thing. Apart from the purely flying pecularities with which pilots must become acquainted, these extremely high rotary speeds place exceptional demands on the strength characteristics of the constructional materials, the joints, the assembly methods and the general precision with which the rotating parts are finished.

It is therefore not surprising that a branch of the aeronautical industry which has been developing turbo-jets for a relatively short time, attaches particular value to research and test facilities enabling the behaviour of materials and assembly units to be controlled very accurately. Boeing Airplane Co., of Seattle, Wash., whose practical experience in turbo-jet development does not extend over more than three years, have therefore designed special "spin pits" in which rotating parts can be whirled at close to 100,000 r.p.m. In principle, this would signify nothing out of the ordinary, since it is a general practice to test parts exposed to high stresses, by loading them to the limit of their resistance ability. Meanwhile, the spin pits in which Boeing's can house 20-inch test turbine components, are made up of 4 ½-inch-thick steel shells, with 3 ½-inch maple blocks on the inside. Since it is not only the centrifugal force on the turbine wheels and blades that has to be taken into account, but most of all the effects of heat, built-in heating coils (nichrome steel

GENERAL VIEW OF BOEING'S "SPIN PIT" ROOM, showing the two testing cells and the intricate control and recording anels. The chamber on the left can be maintained at a constant interior temperature of 1,750 deg. F.



SET-UP FOR PHOTOGRAPHING AT ONE-FIVE-MILLIONTHS OF A SECOND. An engineer is shown holding the tiny mercury flash lamp, which is coupled to a two-thousand volt circuit. Completion of the flash circuit is made in the instant the test object flies apart.

wire embeded in clay holders) maintain an interior temperature of up to 1,750 deg. F. in one of the pits.

Power for the tests is derived from compressed air driving a small turbine which, through a shaft, is attached to the test article. A hoist, supporting the cap plate, air-turbine and accessories, lowers the entire assembly into the pit once the test material is in place. The cap is then firmly clamped and the air evacuated. Since mechanical means will not work at such speeds, the r.p.m. has to be measured optically : the end of the spinning shaft is divided into a black and a white section, on to which a photo-electrical cell is focused ; passage of the black portion causes an impulse to be recorded by instruments which control the speed within 0.5 per cent. accuracy. However, the most important feature of the Boeing spin pit is that it enables test wheels to be studied in the instant in which they fly apart. An ordinary camera is mounted in the cap, and a small mercury lamp serves as light source ; the tripper consists of double concentric copper screens lining the pit. When pieces of the test wheel crash into the screens, they push them into contact and complete the flash circuit. The resulting flash is brilliant enough to allow for a one-five-millionth of a second exposure. The arrangement is so sensitive that the release of even an extremely small bit of metal suffices to close the flash circuit.

In this way, the Boeing spin pit enables the destruction process to be recorded pictorially, and to ascertain which part was the weakest and caused the failure. The engineer, who previously had only battered particles of metal as a "post-mortem" study for determining just what part had first failed, is now in a position to offer accurate judgment and provide suitable remedies.

EFFECTS OF STRUCTURAL FAILURE AT 50,000 R. P. M. in a simulated turbine wheel. The wheel at the left is of the same type as the test pieces on the right. An engineer is examining particles of the wheel to determine failure points. Matched with the photograph of the actual breaking point, the test shows which portion failed in over-speed spinning.

A TURBINE WHEEL BURSTING AT 52,000 R. P. M. The drive-shaft (left) starts to bend as pieces of the turbine wheel break away and throw the assembly off balance. Turbine blades can be seen in the lower right corner as they break and close the flash circuit when they crash into the copper screens.

Official Bulletin of the
FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS
F.A.I.

Competition Rules
for the Prince Georges Bibesco Trophy.

ART. I. — *Foundation.* Princess Bibesco has donated to the F.A.I. a trophy, the value of which is Fr. fr. 500,000, in remembrance of her husband, Prince Georges Bibesco, former President of the F.A.I.

ART. II. — *General Conditions.* The competition is international and open to all member countries of the F.A.I. Aiming above all to encourage private flying, the competition shall be planned in such a way as to develop piloting technique and crew navigation, as well as the quality of aeroplanes which are of special interest to private pilots.

ART. III. — The Georges Bibesco Trophy will be offered to the winner of a competition for the highest average speed over a circuit of at least 5,000 kilometres, consisting of various legs, one of which shall be at least 500 kilometres long.

ART. IV. — Pilots must be holders of a valid private flying licence, issued or approved by their national aero club.

ART. V. — Aeroplanes must be registered in the competitor's country, have not more than four seats, with luggage compartment, and be fitted with the requisite equipment for international navigation.

ART. VI. — Rules for the specific competition shall be published by the country holding the trophy, at least fifteen days before each event. These will contain the conditions of the competition, its date, the circuit, the distance of the longest leg, and the maximum all-up weight of the aircraft. The national aero club having to draw up the competition rules will be in charge of the organisation and control of the competition.

ART. VII. — The competition will take place every two years, beginning in 1949. The French Aero Club has been entrusted with organising the first competition, drawing up the rules and effecting all the preparations.

ART. VIII. — After each competition the Trophy will be the temporary property of the winner's national aero club. It will become the permanent property of the national aero club whose members have won the Trophy three times, whether consecutively or not.

* * *

HOMOLOGATION OF NEW RECORDS

The F.A.I. has homologated the following new records :

WOMEN'S RECORDS

CLASS A (Balloons)

Category 4 : 1,200 - 1,600 cu. metres.
Duration (U.S.S.R.)
Misses L. Ivanova and S. Tonkova
SSSR VR-73 balloon
From the airfield of the Central Aerological Observatory, Dolgorpoudnaia, to Barachevo
22nd-23rd and 24th April, 1948
34 hr. 21 min. 36 sec.

According to Art. 92 of the General Sporting Code, Misses Ivanova and Tonkova also beat the duration records in categories 5, 6, 7 and 8 of Class A.

CLASS D (Motorless aircraft)
Category 1 (single-seaters)
Altitude (France)
Mlle Boselli
Meise 53 sailplane
Saint-Auban-sur-Durance, April 6th, 1948
4,800 metres.

Category 2 (multi-seaters)
Altitude (France)
Mmes Mathé and Gaudry
Kranich No. 32 sailplane
Saint-Auban-sur-Durance, 21st January, 1948
2,883 metres.

MODEL AEROPLANES
(Elastic-band-driven seaplanes)
Duration (Hungary)
Model BM 1 of Mr. Georges Benedek
Rakos Field, Budapest
6th May, 1948 *29 min. 10 sec.*

Distance (Hungary)
Model BM 1 of Mr. Georges Benedek
From Rakos Field to the village of Rakospalota
6th May, 1948 *10.450 km.*

Book Reviews

Cap sans Retour. By Germaine L'Herbier Montagnon. Published by Raoul Solar, Monaco, 1948.

Mrs. L'Herbier Montagnon has set herself the task of writing the "memoirs of the airmen of the Free French Forces — their deeds and their sacrifices." *Cap sans Retour* is the first volume of a series. It is based on accounts given by French pilots who joined General de Gaulle after the Armistice of 1940 : colourful experiences, epical and frequently tragic. The writer deserves every credit for the patience and understanding with which she has reproduced this valuable documentation. (French.) *J.*

La Prochaine Guerre. By Camille Rougeron. Published by Berger-Levrault, Paris, 1948.

The title alone of this book betrays that Mr. Rougeron intends passing in review the formidable instruments of warfare which the stragetists of tomorrow will have at their disposal. With particular emphasis, he proceeds to destroy every illusion of certain optimists who believe in the impossibility of a future war precisely because of the perfection already attained in armament technique. Quite soberly, Mr. Rougeron states that this war will take place — indeed, he almost goes so far as to name the belligerent parties. By thoroughly analysing World War II, he produces a picture of a third world catastrophe. Such "novelties" as atomic, biological, and meteorological warfare are the object of careful study, but in which the author never loses his sense of proportion. Notwithstanding all our technical progress, Mr. Rougeron emphasises, the human factor in a future war will continue to remain dominant. A lengthy chapter is devoted to guerilla warfare, which can prove costlier to the conqueror than the conquest itself. In a review of the newest weapons, the author repeats the majority of the theories which he has already expounded in numerous articles. One chapter is devoted to transport problems, concerning which the author stresses the strategic importance attained by civil aviation. Extremely informative and brilliantly written, Mr. Rougeron's latest book may be warmly recommended to all students of warfare. (French.) *J.*

Airborne Warfare. By Major General James M. Gavin. Infantry Journal Press, Washington, 1947.

The writer, a foremost expert on airborne warfare, reviews every Allied airborne campaign in World War II, but places the emphasis on future developments. As head of the Plans and Training Section of the Parachute Group, and later the Airborne Command, in Washington, Lt. Col. Gavin initiated many of America's basic training doctrines and wrote some of the first U.S. Army textbooks on airborne training and tactics. His battle history is based on notes by himself and others. In 1943, as a colonel, he commanded the airborne regiment which spearheaded the U.S. attack on Sicily. Subsequently made airborne adviser to the Supreme Allied Commander in London, he lent his knowledge and experience to the architects of the Normandy landings, later actually to lead the assault parachute echelon of the 82nd Airborne Division into Normandy. At 37 he was made division commander and a major general, and as such led the 82nd to fame in Holland, Belgium and Germany.

It goes without saying that he does not deny the potentialities of the armament branch he has helped to pioneer since 1940. But in his criticism of these potentialities, he uses data furnished by technical and tactical experience and research. He disagrees with Douhet's and De Seversky's opinions on victory solely though air power, and foresees a ground follow-up after an airborne operation.

Anyone wishing for a objective picture of airborne tactics and strategy will find satisfaction in this book. *He.*

Survival in the Air Age, the report published on January 1st, 1945, by President Truman's Air Policy Commission (Chairman, T.K. Finletter), which gave directives for America's armament in the air, has been translated into French by the Documentation and Technical Information Service of the French Air Ministry. French title : *Paix et Sécurité à l'Age de l'Air.*

THE MONTH IN REVIEW

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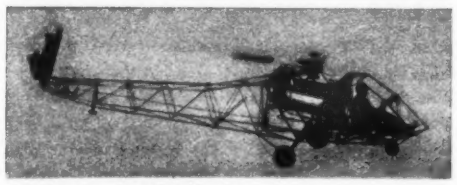
AVIATION POLITICS

● Civil aviation agreements have been concluded between : Holland and Canada, Argentina and Brazil, Great Britain and Italy (on June 25th in Rome), India and Pakistan (on June 24th in Karachi).

FIRST FLIGHTS

* The Douglas XF3D-1 two-seater twin-jet fighter prototype, built for the U.S. Navy, has made its first flight. Power plant consists of two Westinghouse 24 C turbo-jets of 3,000 lbs. static thrust each, mounted parallel in the fuselage underside.

● The SE 3101 single-engined experimental helicopter, built by SNCA du Sud-Est, made its first successful hovering trials on June 16th and 17th. Powered with a Mathis G 4 R air-cooled flat-four of 100 H.P. for take-off, the new helicopter is primarily to furnish research data on the new type of rotor configuration (one main rotor and two auxiliary rotors).



SE 3101 experimental helicopter.

● The prototype of the Avro T. 1 "Athena" three-engined trainer, powered with an Armstrong-Siddeley "Mamba" airscrew-turbine, made its first successful test flight on June 12th.

● The second prototype of the U.S. Navy's Lockheed XR-60 "Constitution" four-engined giant transport aircraft successfully completed its first test flight on June 13th. Take-off and landing were made from the 6,000-foot runway at Lockheed Air Terminal, Burbank, Cal.

Lockheed XR-60 "Constitution."

NEW AIRCRAFT

● The Yakovlev Yak-18 is a newly-developed Soviet two-seater trainer. It is a cantilever low-wing monoplane with enclosed seats, single fin and rudder unit and retractable tail-wheel undercarriage. Fully equipped with blind-flying instruments, it is powered with a 160-H.P. five-cylinder radial, driving a two-blade controllable-pitch airscrew. Span, 34 ft. 9 1/4 in. ; length, 26 ft. 4 1/4 in. ; gross weight, 2,360 lbs. ; maximum speed, 159 m.p.h. ; cruising speed, 133 m.p.h.

* Excerpts from Nos. 1477-1488 (June 4th to July 2nd, 1948) of "Interavia, International Correspondence on Aviation," an illustrated newsletter published three times a week in three separate language editions, English, French and German.

Chase XCG-18A "Avitruc" cargo glider.

● The prototype of the Chase XCG-18A "Avitruc" all-metal assault glider is being subjected to thorough flight tests by the U.S. Air Force. Maximum towing speed so far has been 216 m.p.h. The Chase Aircraft Co., Inc., of Trenton, N.J., has received an order for five "Avitrucs" for USAF Tactical Air Command. They are intended for use in joint operations with field forces and airborne troops.

● The prototype of a new jet-propelled anti-submarine patrol aircraft, developed for the U.S. Navy by North American Aviation (at the time of writing we assume this to be the XAJ-1), is expected to start its trial flights shortly. The manufacturers are tooling up for quantity production and negotiations are under way for a production order.

● Following initial power plant tests on June 12th, the Breda-Zappata BZ 308 four-engined airliner has been taken out of the plant of S.A. Italiana Ernesto Breda at the Sesto San Giovanni factory airfield, near Milan, for taxi trials. It will be equipped with 55 seats for trans-Atlantic operations, a forward compartment accommodating 24 and a rear compartment 31 passengers. Power plant consists of four Bristol "Centaurus 59" air-cooled 18-cylinder twin-row radials of 2,500 H.P. take-off power ; airscrews are of five-blade controllable-pitch design.

Breda-Zappata BZ 308.

● Lockheed C-121 is the designation of the military version of the "Constellation," ten of which were recently ordered by the USAF. The C-121 is a modified production version of the C-69, the original military version of the "Constellation." Of the ten aircraft, nine are to be cargo type transports and the remaining one a passenger model. The ten machines will be assigned to the Military Air Transport Service, to whom they will probably be delivered before the end of the year.

● The Sezione Aeritalia of the Fiat concern is now flight-testing the Fiat G. 59 fighter-trainer prototype, derived from the Fiat G. 55 fighter-trainer. Details are not available, except that the G. 59 is powered with a Rolls-Royce "Merlin 24" liquid-cooled 12-cylinder in-line engine of 1,610 H.P. for take-off. Fiat hopes to sell the G. 59 in South America.

● A Commonwealth CA-15 single-engined fighter flew at speeds of over 500 m.p.h. during recent experimental flights. Manufactured by the privately-owned Commonwealth Aircraft Corp. (Pty.) Ltd., of Fishermen's Bend, Melbourne, the CA-15 was at one time intended as a replacement type for the North American P-51 "Mustang" in service with the RAAF. However, progress in the field of jet fighters caused CA-15 production to be suspended and the D. H. "Vampire" chosen as the RAAF's post-war fighter equipment.

● The Morane MS-700 is a four-seater twin-engined personal aircraft, specially designed for colonial service in France and now being developed by S.A. de Constructions Aéronautique Morane-Saulnier. It is powered with two 180-H.P. Potez engines.

● Boeing C-94A is the designation of the transport version of the Boeing B-50 four-engined bomber. One of the first models has started flights tests at Wright Field.

● Lockheed Aircraft Corp. has a new version of the F-80 "Shooting Star," the F-80C, in production. Development of the F-80C was begun a year ago, in secret experiments conducted by the USAF, Lockheed and Allison at the Muroc Test Center, Calif. The F-80C has the same dimensions as the F-80B, the earlier improved version of the F-80, but has a more powerful engine, an Allison J-33-23 (manufacturer's designation, Allison 400) jet engine of 4,600 lbs. static thrust (at 11,750 r.p.m.).

INDUSTRY

● The de Havilland Engine Co., Ltd., is tooling up for the production of the de Havilland "Ghost" turbo-jet (5,000 lbs. static thrust).

● An order for twelve de Havilland DHA-3 "Drover" three-engined small transport aeroplanes has been placed with The de Havilland Pty., Ltd., in Sydney, by the Australian Federal Government. The aircraft are to be used by Trans Australia Airlines and Qantas Empire Airways.

● Aeronautica Macchi S.A., of Varese, announces plans to step up production of the M.B. 308 personal aircraft to ten machines monthly.

Float version of Macchi M.B. 308.

● Of 153 "Constellations" ordered since the end of the war, Lockheed Aircraft Corp. had delivered 132 units by the middle of last June.

RESEARCH

● British experts, members of the staff of the Director of Long-Range Weapons Projects of the Ministry of Supply (Lieut.-General Sir John Evatts), are studying Tasmania's suitability as a British aeronautical research centre. Sir Ben Lockspeiser, Chief Scientist of the British Ministry of Supply, made it clear when visiting Australia recently that the British Government planned to establish wind tunnels and supersonic test equipment either in New Zealand or Tasmania.

INTERNATIONAL ORGANISATIONS

● ICAO : On June 10th, the Second Assembly of the International Civil Aviation Organisation, in Geneva, unanimously approved the applications of Austria and Finland for admission. At a special conference held on June 8th, the joint financing through ICAO of the traffic control, radio communications and meteorological services in Iceland was discussed by nations whose airlines operate trans-Atlantic services (Belgium, Canada, Denmark, France, Great Britain, Holland, Iceland, Norway, Sweden and the U.S.A.). The cost of operating the envisaged facilities was estimated at $600,000 annually.

● IATA : During recent meetings in Paris of the IATA Traffic Conference for Region No. 2 (Europe, Africa and the Middle East), it was decided to retain present tariffs for North and South Atlantic services, due to expire August 31st, until March 31st, 1949. New fare schedules for the coming winter season include : minimum surcharge of $45 for sleeper service on the North Atlantic ; discount of 50 per cent. on certain long-distance routes for children attending school outside their parents' country of residence ; and special 15-day excursion rates on certain European routes, reducing some fares to 75 per cent. of a normal return ticket.

AIR TRANSPORTATION

● The world's scheduled airlines, excepting those in the U.S.S.R., flew 650,000,000 aircraft-miles and 11,300,000,000 passenger-miles in 1947, according to the ICAO Air Transport Statistical Summary No. 1.

● INTER-CONTINENTAL : Philippine Air Lines plans to extend its weekly Manila—Bangkok—Calcutta—Karachi—Cairo—Rome service to London on July 5th. Application has also been made to the French Secretariat of Civil and Commercial Aviation for permission to land at Paris on this last leg. Douglas DC-6's are used.

● British Overseas Airways is to sell its nine Short "Hythe" class flying-boats, which will be replaced on the London—Sydney route by the recently acquired Lockheed 749 "Constellations."

● Air France put two new Latécoère six-engined flying-boats on its West Indies service on June 15th. These flying-boats offer, for the first time in airline history, first and second class accommodation : 15 first class cabins, each with two berths, and 24 normal passenger seats for the second class. Thus the new Latécoère 631's carry 54 passengers instead of the 46 of the earlier version.

● Scandinavian Airlines System announces that its projected routes to the Far East and South Africa will be opened in November or December and operated with Douglas DC-6's, initially fortnightly and later weekly. The 9,500-mile Stockholm—Shanghai trip will be flown in 66 hours, and the 7,300-mile Stockholm—Johannesburg route in 53 hours.

● The Anglo-Vaal Air Transport Co. (formerly known as A.V. Air Transport), a major South African overseas charter operator, has merged with Skyways Ltd., the most important British charter line.

● Pan American World Airways will not use its Boeing "Stratocruiser" fleet on services to South Africa, according to the carrier's annual report. Lockheed "Constellations" will continue to be used for economic as well as technical reasons, amongst the latter being the inadequacy of Leopoldville airport, Belgian Congo.

● EUROPE : On June 4th, Air France and K.L.M. Royal Dutch Airlines celebrated the 25th anniversary of the first air connection between France and Holland.

● K.L.M. Royal Dutch Airlines ordered two additional Lockheed 749 "Constellations" from Lockheed Aircraft Corp. on June 18th. When these are delivered, K.L.M.'s "Constellation" fleet will total nineteen.

● K.L.M. Royal Dutch Airlines' route network now covers 62,170,000 miles. Longest routes are Amsterdam—Batavia (8,200 miles) and Holland—South America (8,006 miles).

● The three British state-owned airlines carried 50 per cent. more traffic in the year ended March 31st, 1948, than in the previous year. Passenger traffic rose 25 per cent. on international services, 69 per cent. on domestic operations (by B.E.A.C.).

● British European Airways is installing an additional seven seats in 16 of its Douglas DC-3's used on internal routes in Britain, thus bringing the aircraft's seating capacity up to 28. A number of 28-seater DC-3's were used in the U.S.A. during the war, but the arrangement was abolished at the end of hostilities as accommodation was extremely cramped. The measure is part of B.E.A.'s economy drive and follows upon the recent increase in the capacity of its Vickers "Vikings" from 24 to 27 seats.

● S.A.A. has registered a company of its own in Britain, known as Scandinavian Airlines System, Limited. A similar S.A.A. subsidiary in the United States (Scandinavian Airlines, Inc.) has been in existence in New York for some time.

● Polska Linie Lotnicze, the Polish carrier, flew 1,087,620 aircraft-miles during 1947. LOT flies its 3,700-mile domestic and 2,800 mile foreign networks with 31 Douglas DC-3's and Russian IL-2's, and 5 Languedoc 161's.

● Swissair's personnel now totals 1,423, against 789 at the end of 1946 and 1,273 at the end of 1947.

● ATLANTIC : North Atlantic airline companies carried a total of 194,236 passengers in both directions during 1947, compared with 104,980 in 1946, according to a recent study made by the U.S. Civil Aeronautics Board. More than 67 per cent. of the foreigners and nearly 80 per cent. of the Americans travelled by one of the U.S. flag airlines.

● The second anniversary of Air France's North Atlantic service (opened on June 26th, 1946), was marked by the 900th regular flight over the route ; the company's 23,000th North Atlantic passenger was carried on this flight.

● On June 15th, Trans World Airline stepped up its trans-Atlantic passenger schedule from 17 to 22 round trips weekly. This increase is made possible by the introduction of 7 of the 12 Lockheed 749 "Constellations" which the airline ordered earlier this year.

● Island Liftleidir H/F's projected service from Iceland to New York or Chicago was authorised on June 25th by the U.S. Civil Aeronautics Board. Initially, the line will operate at least six regular flights each month with its Douglas DC-4 on a non-scheduled basis. It is at present negotiating for the purchase of more DC-4's with which to start a scheduled service.

● American Airlines placed its fiftieth and last DC-6 airliner in scheduled passenger service on June 10th, thus completing the first phase of its re-equipment programme. The second phase, replacement of DC-3's with "Convair-Liners," will be completed by early 1949.

● United Airlines' entire fleet of 33 Douglas DC-6's is now in operation, following the return to service of the last modified aircraft. U.A.L. has six more DC-6's on order, and anticipates delivery this summer.

● Northwest Airlines started operating Martin 2-0-2 airliners from Minneapolis to the West Coast in June 1st, thus providing a complete trans-Continental service with this type of equipment. Of 25 units ordered, the carrier has now received fourteen.

● Trans Worl dAir line announces that it now has a fleet of 132 aircraft : 78 Douglas DC-3's, 15 DC-4's, 34 Lockheed "Constellations" and 5 Boeing 307 "Stratoliners." This fleet flies a route mileage of nearly 30,000, serving 68 cities in 15 countries.

● NON-SCHEDULED OPERATIONS : Transocean Air Lines, of Oakland, Calif., has been awarded a three-year contract to fly 25,000 displaced persons from Munich to Caracas, Venezuela, by the International Refugee Organisation. Transocean has also been awarded a contract by a youth organisation, to transport over 700 American students to Europe and back this summer.

● Airwork Ltd., the large British charter carrier, has been awarded a £1,200,000 contract by the International Refugee Organisation to fly displaced persons from Hamburg to Montreal. It is planned to fly 17,500 D.P.'s in the first year of the contract, which went into effect at the beginning of June.

● An aerial car ferry service has been announced by Silver City Airways, a British charter company. Cars and their passengers will be flown in 20 minutes from Lympne Airport, Folkestone, to Le Touquet, in Bristol 170 cargo aircraft.

SERVICE AVIATION

● The Swedish Parliament has decided to strengthen all ten Air Force day fighter squadrons by 50 per cent. Further expansion of the Air Force will only be decided definitely in 1949.

● The 1949 U.S. Navy Appropriations Bill includes about $6,000,000 for initial construction of a 65,000-ton aircraft carrier (design designation, 6-A), of which the estimated cost at the time of completion will be about $124,000,000. Featuring a length of 1,090 feet and a beam of 130 feet, it will be powered with steam turbines developing around 280,000 H.P. The vessel's aircraft complement will include more than twenty bombers (powered with airscrew-turbines), each weighing about 50 tons all-up ; these aircraft, of unspecified type, are reported to be in an advanced design stage, to be capable of maximum speeds between 460 and 520 m.p.h., and to have an operating radius of about 2,000 miles.

● Singapore will again become the main British base in the Pacific. Work on a very large airfield at Changi, just outside Singapore, was started some time ago by the R.A.F.

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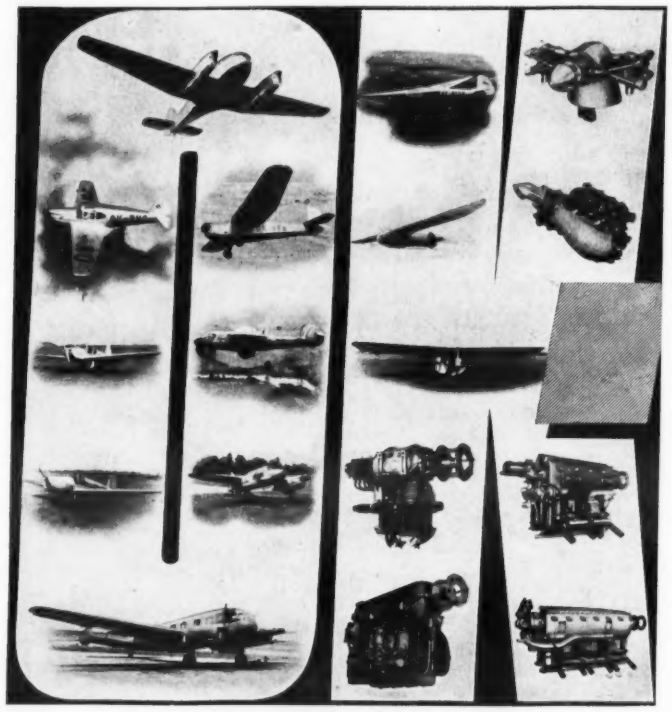

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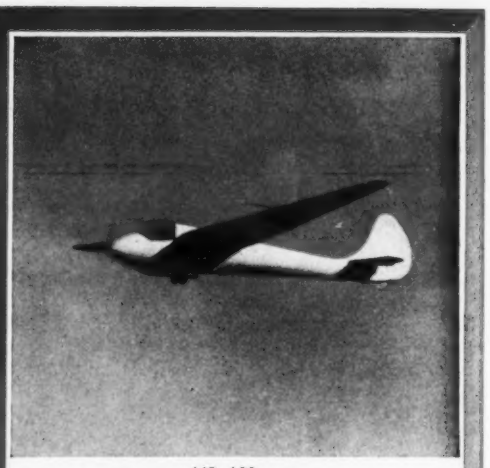

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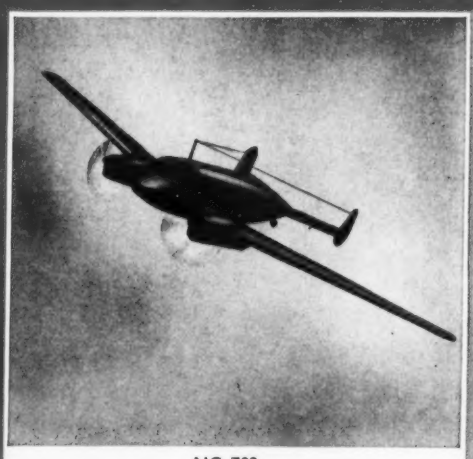

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